Construction Site Erosion and Sediment Control Certification Course

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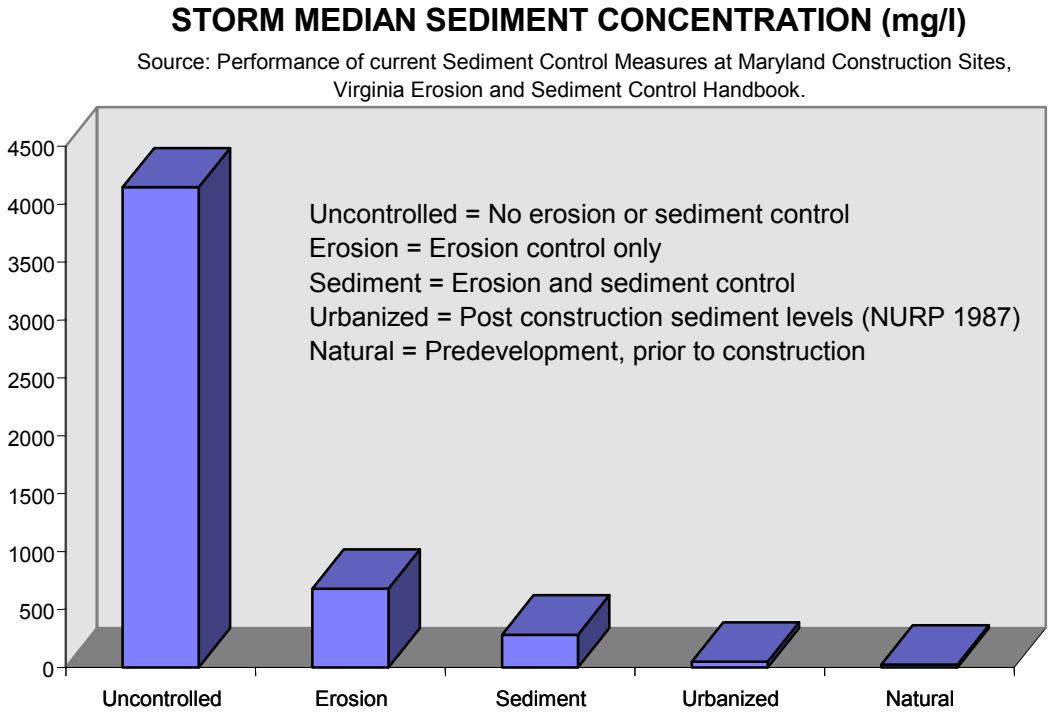
Section 1

1.1 WSDOT Erosion Control Program

1.1.1 Introduction

Construction projects often expose large areas of soil that significantly increase the potential for soil erosion. Unprotected construction sites may have erosion rates exceeding 1,000 times the pre-construction rate (Figure 1.1). Uncontrolled soil erosion can damage construction projects and the surrounding environment, especially if eroded sediments enter surface waters. Consequently, prevention is a high priority for the Washington State Department of Transportation (WSDOT).

Figure 1.1 Construction Site



WSDOT has developed an overall program to protect water quality while completing its mission of building and maintaining a quality transportation system. This program is outlined in the *Highway Runoff Manual*, which is equivalent to the Department of Ecology's *Stormwater Management Manual for the Puget Sound Basin*.

This document is to be used primarily as the training manual for the Construction Site Erosion and Sediment Control Certification course. It should be used as a resource, in addition to the *Highway Runoff Manual*, *Design Manual*, and *Construction Manual Standard Plans*, and *2004 Standard Specifications for Road, Bridge and Municipal*

Construction, by anyone designing, implementing, and inspecting TESC plans. Material presented in this manual is also available at the WSDOT Erosion Control Program website located at: http://www.wsdot.wa.gov/eesc/environmental/programs/hazwqec/wqec.htm. The website provides links to all products, guidance documents, websites, and other educational resources presented in this course.

Objectives

Understanding the Basics of:

- WSDOT Erosion Control Program
- Regulatory Framework
- Erosion Process
- Factors Affecting Erodibility
- Erosion Control vs. Sediment Control

Using Best Management Practices (BMPs):

- Design BMPs
- Procedural BMPs
- Physical BMPs
- Erosion Control
- Sediment Control

Becoming Familiar with:

- New Products
- Soil Bioengineering
- Erosion Control Planning
- Spill Prevention Planning

1.1.2 Highway Runoff Manual Minimum Requirements

The *Highway Runoff Manual* contains nine minimum requirements that WSDOT employs to protect surface waters. Erosion and sedimentation control is largely dealt with in Minimum Requirement 1, but it is relevant to all of the minimum requirements.

Minimum Requirement 1 – Stormwater Planning

All projects that meet the thresholds in Section 2-2 require Stormwater Planning. The two main Stormwater Planning components are Construction Stormwater Pollution

Prevention Planning and Permanent Stormwater Control Planning. With WSDOT's specialization of disciplines, size of projects, and programmatic approach to contracting and maintenance, a combination of documents are used to meet Stormwater Planning requirements. Multiple documents are also required because stormwater issues are thoroughly integrated into WSDOT's design, construction and maintenance programs. Construction Stormwater Pollution Prevention Planning components consist of Spill Prevention, Control, and Countermeasures (SPCC) plans and Temporary Erosion and Sediment Control (TESC) plans. Permanent stormwater control planning components include Hydraulics Reports and the Maintenance Manual.

Minimum Requirement 2 - Construction Stormwater Pollution Prevention

All projects must address Construction Stormwater Pollution Prevention, of which the main components are:

- Temporary Erosion and Sediment Control (TESC) plans.
- Spill Prevention Control and Countermeasures (SPCC) plans.

SPCC plans are prepared by the contractor and are required on all WSDOT projects regardless of size or activities. The contents of the SPCC plan are described in Section 1.1.5 below.

Projects that disturb 7,000 square feet or greater of land must prepare a TESC plan in addition to a SPCC plan. The TESC plan must address the 12 elements described in Section 4.

Minimum Requirement 3 - Source Control of Pollutants

All known and reasonable source control BMPs must be applied to all projects. Source control BMPs must be selected, designed, and maintained in accordance with the Highway Runoff Manual.

Minimum Requirement 4 – Maintaining The Natural Drainage System

Natural drainage patterns shall be maintained and discharges from the site shall occur at natural locations.

Minimum Requirement 5 - Runoff Treatment

Projects that meet certain thresholds described in section 2-2 of the HRM must provide permanent runoff treatment using physical, biological, and chemical methods.

Minimum Requirement 6 - Flow Control

Unless an exemption applies, the project must provide flow control of stormwater runoff from the newly created impervious surface. This requirement applies to projects that

discharge stormwater directly, or indirectly through a conveyance system, into a fresh water receiving water.

Minimum Requirement 7 - Wetland Protection

Discharges to wetlands must maintain the hydrologic conditions, hydrophytic (wetland) vegetation, and substrate characteristics necessary to support existing and designated uses. The requirements for Minimum Requirement 5, Runoff Treatment, must also be met for stormwater discharges into a wetland.

Minimum Requirement 8 - Incorporating Watershed-Based/Basin Planning and Local Requirements Into Stormwater Management

Many regions of Washington have basin plans in place that may subject projects to equivalent or more stringent minimum requirements for erosion control, source control, treatment, operation and maintenance, and alternative requirements for flow control and wetlands hydrologic control.

Minimum Requirement 9 - Operation and Maintenance

An operation and maintenance manual that is consistent with the guidance in Chapter 5 of the HRM must be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for such maintenance and operation must be identified. A log of maintenance activities must be kept and be available for inspection by the local government.

1.1.3 Temporary Erosion and Sedimentation Control Plan (Section 4)

A TESC plan must be prepared if a construction project adds or replaces (removal of existing road surface down to base course) more than 2,000 square feet of impervious surface or disturbs more than 7,000 square feet of soil. Projects that disturb less than 7,000 square feet of soil must address erosion control, but a stand-alone TESC plan is optional.

The TESC plan establishes when, where, and how specific BMPs will be implemented to prevent erosion and the transport of sediments from a site during construction. All TESC plans must address the 12 elements described in Section 4 of this document and in the *Highway Runoff Manual*.

1.1.4 Standard Specifications, General Special Provisions, & Standard Plans

The *2004 Standard Specifications for Road, Bridge, and Municipal Construction* are published and discussed in greater depth in Section 4.4 of this manual. A complete electronic copy is available online at http://wwwi.wsdot.wa.gov/eesc/cons/pdfs/SS2004b.pdf

General Special Provisions (GSPs) or Special Provisions are used whenever a Standard Specification does not adequately address specific needs of a project.

In some cases it is not necessary to write your own because many have been written for common erosion problems and can be accessed from existing libraries. The statewide library for GSPs and Special Provision is located at http://www.wsdot.wa.gov/eesc/design/projectdev/gsppage1.htm. Some of WSDOT's regional offices have their own libraries that can be accessed by contacting the regional plans offices. If there is no suitable provision available that can be used, one will have to be written.

Standard plans are available for numerous erosion control BMPs and can be downloaded from the design office website at http://www.wsdot.wa.gov/eesc/design/designstandards/newstdplans.htm. The standard plans provide the correct installation specifications for BMPs such as silt fence, check dams, wattles, inlet protection, and erosion control blankets.

1.1.5 Spill Prevention Control and Countermeasures (SPCC) Plan

All WSDOT projects require the contractor prepare a SPCC plan. It describes the BMPs that will be employed to prevent the contamination of a site from all forms of pollution other than sediment. The contents of the SPCC plan include:

- Site information and project description.
- Spill prevention and containment.
- Spill response.
- Material and equipment requirements.
- Reporting information.
- Program management.
- Plans to contain preexisting contamination (if necessary).

Numerous courses are offered to WSDOT and contractor personnel in SPCC planning and inspection. Information on these courses is provided in Section 5.

1.1.6 Erosion and Sediment Control Lead

Since 1997, certified Erosion and Sediment Control (ESC) Leads have been required on all WSDOT projects involving earthwork. The qualifications and responsibilities of the ESC Lead are described in section 8-01.3(1)B of the *Standard Specifications*.

Page 8-2 2004 Standard Specifications
8-01.3(1)B Erosion and Sediment Control (ESC) Lead
The Contractor shall identify the ESC lead at the preconstruction discussions. The ESC Lead shall have, for the life of the contract, a current Certificate of Training in Construction Site Erosion and Sediment Control from a course approved by WSDOT's Statewide Erosion Control Coordinator. The ESC Lead shall implement and update the Temporary Erosion and Sediment Control (TESC) plan. Implementation shall include, but is not limited to:

1. Installing, maintaining, inspecting and repairing all temporary erosion and sediment control Best Management Practices (BMPs) included in the TESC plan to assure continued performance of their intended function. All on-site

erosion and sediment control measures shall be inspected at least once every five working days, each working day during a runoff-producing rain event, and within 24 hours after a runoff-producing rain event. Damaged or inadequate TESC measures shall be corrected immediately. A TESC Inspection Report shall be prepared for each inspection and shall be included in the TESC file. A copy of each report shall be provided to the Engineer. The inspection report shall include, but not be limited to:

a. When, where and how BMPs were installed, maintained, modified, and removed;
b. Repairs needed and repairs made;
c. Observations of BMP effectiveness and proper placement;
d. Recommendations for improving performance of BMPs.

2. Preparing, maintaining, and updating a TESC file on site that includes, but is not limited to:

a. TESC Inspection Reports.
b. Stormwater site plan.
c. Temporary Erosion and Sediment Control (TESC) Plan.
d. National Pollutant Discharge Elimination System construction permit (Notice of Intent).
e. Other applicable permits.

Upon request, the file shall be provided to the Engineer for review.

Thousands of people have completed the course to date and are making significant improvements to the overall quality of erosion control planning and implementation on WSDOT projects. Re-certification is required every three years to keep training consistent with changing regulations and technologies.

1.1.7 Outside Training Organizations

The following organizations have been approved by WSDOT to provide erosion control certification training courses:

- AGC of Washington Education Foundation
  http://www.agcwa.com/Public/education/classes.asp#env
- Northwest Laborers- Employees Training Trust Fund
  http://www.nwlaborerstraining.org/classes/kingstonclass2.html
- Inland Northwest AGC
  http://www.northwestagc.net/

1.2 Laws and Regulations

1.2.1 Introduction

Construction site erosion has the potential for impacting regulated water bodies. Federal, state, and local jurisdictions may all have water quality protection requirements that cannot be met without adequate erosion and sedimentation control measures. Consequently, WSDOT's projects usually require permits regulating the activities that could impact water quality.

1.2.2 The Clean Water Act

Water pollution is regulated under the Federal Water Pollution Control Act of 1972, known as the Clean Water Act (CWA). The CWA established effluent discharge limitations and receiving water quality standards under United States Environmental Protection Agency regulation (EPA). Enforcement of the CWA has been delegated to the Washington State Department of Ecology.

Until the mid-1980s, emphasis was on control of point source pollution, typically outfalls from industrial factories and municipal sewage treatment plants. The CWA was amended in 1987 to include non-point sources of pollution.

Point Source Pollution:
Pollution originating and discharged from a discreet location, typically outlets from industrial factories and municipal sewage treatment plans.

Non-Point Source Pollution:
Pollution originating from diffuse, diverse activities, and land uses in a watershed that enters a water body through non-discernible, unconfined and indistinct conveyances.

Stormwater pollution generally originates as nonpoint pollution, but is typically collected, conveyed and discharged as a point source.

1.2.3 National Pollutant Discharge Elimination System (NPDES) Permit

NPDES permits are currently required on WSDOT projects that involve disturbance of 5 acres. As a result the NPDES permit (commonly referred to as General Stormwater Permit) is the most commonly encountered construction permit on WSDOT construction projects. NPDES permits require, among other things TESC and SPCC plans.

The Washington State Department of Ecology has published numerous guidance documents relating to NPDES and other construction-related permits including the *Guidance Document for Applying for Ecology's General Permit to Discharge Stormwater Associated with Construction Activity*, and *Working in the Water*. These and other publications can be found on the Ecology website at:
http://www.ecy.wa.gov/programs/wq/stormwater/construction/ - reissue

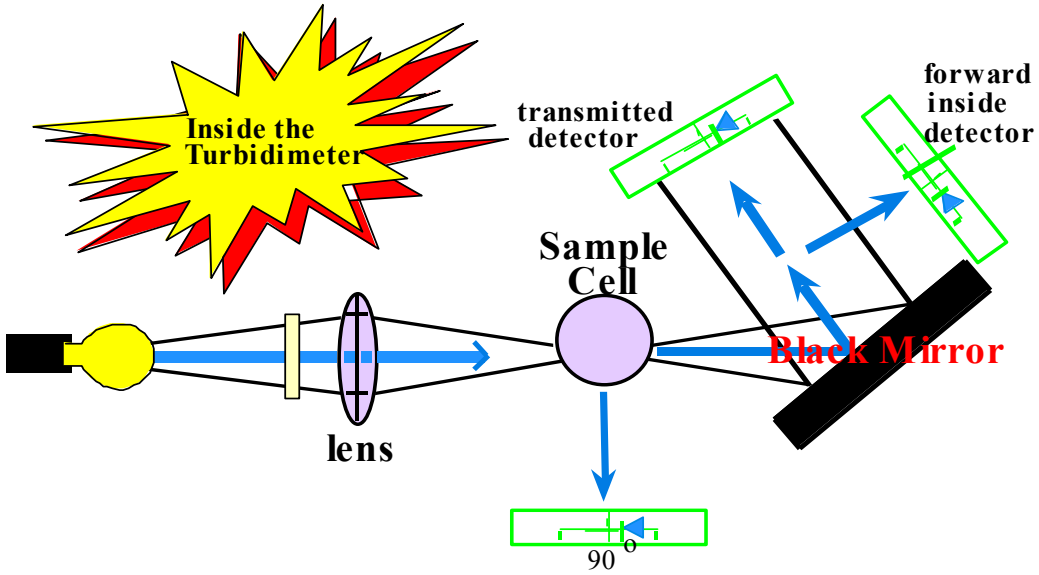
1.2.4 State Water Quality Standards

The Washington State Department of Ecology established effluent discharge limitations and receiving water quality standards under the CWA. The water quality standards are in Chapter 173-201A of the Washington Administrative Code (WAC). It can be accessed on the Ecology web site at: http://www.ecy.wa.gov/biblio/wac173201a.html. There are numerous water quality standards listed in 173-201A WAC including standards for turbidity, pH, dissolved oxygen, temperature, etc. However, turbidity and pH are the most

common parameters associated with enforcing water quality standards on construction projects.

Turbidity is measured in nephelometric turbidity units (NTU) using a turbidimeter. A turbidimeter works by measuring the amount of light that is deflected by the suspended material in the test sample. Pure water has a turbidity of zero, while muddy water can have turbidity as high as 1000 NTU to several thousand NTU.

Figure 2.1.1 How Turbidity Is Measured



Light is scattered by sediment particles when it passes through water. The scattered light is measured giving the turbidity

Turbidity standards for discharges to surface waters vary with the turbidity of the receiving waters. For most state waters the water quality criteria for turbidity and general water quality is as follows:

- Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
- Aesthetic values shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

The acidity or alkalinity of discharge water from construction sites, measured as pH, is monitored because elevated levels can directly harm aquatic resources. The pH scale ranges from 0 to 14, with a pH of 7 being neutral. Levels higher than 7 are alkaline and lower than 7 are acidic. Construction projects are most likely to have more alkaline or elevated pH levels as a result of concrete grinding, saw cutting, concrete placing, and truck washing, for example. The standard for pH is no increase greater than 0.5 over background.

Mixing zones may be allowed under certain conditions on some sites. A mixing zone is defined in state law as "that portion of a water body adjacent to an effluent outfall where mixing results in the dilution of the effluent with the receiving water. Water quality criteria may be exceeded in a mixing zone as conditioned and provided for in WAC 173-201A-100." The use, size, and location of mixing zones are established in permits or orders by the Department of Ecology.

Increasing numbers of WSDOT high-risk erosion and in-water work projects are required to monitor discharge water quality to demonstrate compliance with State water quality standards, mostly with regards to turbidity and pH standards. Such projects must follow the standard protocols for water quality monitoring protocols described in WSDOT Instructional Letter 4049 (IL 4049). These protocols provide standardized procedures for station set-up, sample collection, and data reporting. Monitoring data provides important information on BMP effectiveness for individual projects and overall agency performance in meeting water quality commitments.

1.2.5 Endangered Species Act

The Endangered Species Act of 1973, as amended, was adopted to prevent the extinction of animals and plants. The ESA protects endangered species by prohibiting "the take of listed species without special permit" where:

- Take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect or the intent to engage in such activities. Harm includes indirect harm to listed species by harming the habitat.

Several stocks of salmon and bull trout have been added to the list of species protected by the ESA. These listed species inhabit waters in all regions of the state. Accordingly, protection of endangered fish species is considered on nearly all projects.

Adequate erosion and sediment control is essential for complying with the ESA where construction runoff enters state waters inhabited by protected species. Sites that fail to comply with erosion and sediment control requirements may violate the ESA by taking listed species through:

- Directly killing or harming listed fish: Clogging or damaging gills and, smothering eggs with sediment, or
- Indirectly harming fish by modifying or degrading their habitat to the point that it significantly impairs essential behavior patterns, including breeding (i.e., clogging spawning gravel), feeding (i.e., reducing light penetration and food supply), or sheltering (i.e., filling pools with sediment).

1.2.6 Other Laws and Permits

Other laws and permits may also be required on WSDOT projects. The following laws and permits may all have conditions that are associated with water quality and erosion control.

- Washington State Department of Fish and Wildlife Hydraulic Project Approval (HPA) Permit
- Local grading permits
- Right-of-Way Management Sensitive Areas Ordinance
- Shoreline Management Substantial Development Permit
- Ecology Water Quality Certification (Section 401 of the CWA)
- Coastal Zone Management Act
- Puget Sound Water Quality Management Plan (WAC 173-270)

1.3 Impacts of Erosion & Sedimentation

1.3.1 Fisheries

Clogged Spawning Gravel
Impaired Feeding
Damaged Fish Gills
Smothered Eggs
Reduced Light Penetration (reduced food)

1.3.2 Construction

Construction site damage by erosion diverts money, manpower, and equipment. Project delivery may be delayed as well.

Legal Issues
Stop Work Orders
Regulatory Fines
3rd Party Lawsuits

1.3.3 Offsite Mitigation

Stop Work Orders
Regulatory Fines
3rd Party Lawsuits

1.3.4 Examples of the High Costs of Neglecting Erosion Control

3rd Party Lawsuit-Section 505 of the Clean Water Act

A Public Agency Violated NPDES Construction and Industrial Permits

- Cost: $25 million

- Court-ordered compliance and oversight
- $ 1.5 million annual consultant fees

Stop Work Order

A Major Bremerton Retailer

- 74 day shutdown-erosion and sediment control work only
- Lost revenue from two month opening delay
- Lost revenue from angry local residents
- DOE fine ($65,000)
- Estimated total cost- Over $2 million

Maintenance Costs (Caused by inadequate BMPs)

- Clogged conveyances ($70,000 on a single WSDOT project in King County)
- Ditch cleaning of sediment from eroding slopes
- BMP removal
- Reseeding
- Filled sedimentation ponds ($14,000 on a single WSDOT project in King County)

Mitigation

- Highway project involving sediment removal from private property
- Wetland and sensitive area restoration ($70,000 on a single WSDOT project in King County)

Civil and Criminal Penalties

Anyone who intentionally breaks the Clean Water or Endangered Species Acts may be held civilly and criminally responsible. One state resident was sentenced to two years in prison for willfully violating permit conditions.

Endangered Species Act Potential Impacts?

- Lost or reduced Federal funding due to non-compliance
- Increased scrutiny from local, state, and federal resource agencies
- Land-use changes that threaten new road building
- Increased citizen scrutiny and legal savvy
- Third party lawsuits
- Increased amount of fines

1.3.5 Importance of Sufficient TESC Planning

Inadequate erosion control can lead to serious regulatory and economic setbacks to project delivery. WSDOT conducted a study to assess the costs of erosion control in the field. The study included a review of approximately 89 projects completed in 2001. From that study, it was determined that 28 or approximately one-third of the projects were over budget for the line item water pollution prevention/erosion control. Only 18 projects, however, were responsible for the majority of cost overruns. The 18 projects were budgeted at $600,000 for water pollution prevention/erosion control, but a total of $2.6 million was spent. Those 18 projects were responsible for 80 percent of total erosion control spending for that year.

In an earlier study conducted on WSDOT projects from 1995-1999, a similar pattern emerged where very few projects were responsible for a majority of erosion control spending. Most of the projects experienced some form of site damage (90%) while progressively fewer encountered water quality violations (60%) and offsite damage to neighboring properties (40%).

Water quality and offsite damage virtually guarantee regulatory and/or legal involvement. If site damage can be avoided altogether, then it stands to reason that water quality violations and offsite damage can be avoided as well.

1.4 Reporting Non-Compliance and Resource Agency Erosion Enforcement Guidance

1.4.1 Reporting Non-Compliance – IL 4055

This course is designed to help you keep your construction projects in environmental compliance. There will be times, however, when problems will arise despite the best efforts to implement BMPs. Regardless of the reason, if site runoff fails to meet water quality standards, the notification procedures described in WSDOT Instructional Letter 4055 must be implemented immediately by the contractor and WSDOT management. This IL describes "notification triggers" and follows a step-by-step notification procedure from the contractor who discovers the problem to the WSDOT Regional Administrator and director of Environmental Services.

1.4.2 Resource Agency Inspection

Resource agencies are responsible for enforcing the CWA and inspectors are more likely to visit a WSDOT site if it is having erosion problems. When this happens there are certain things you can do to increase your chances for a positive outcome. This section has been created to help WSDOT and the contractor best handle a regulatory inspection.

Due to the high workload of agency enforcement staff, they usually only come out to a site in response to complaints from the public. Resource agency enforcement staff do not know much about each project until they visit the site and speak with the project representative (the WSDOT Project Engineer or one of the inspectors) and the ESC Lead.

Like all regulatory inspectors, resource agency inspectors want to work with you to correct problems as quickly as possible. They expect cooperation and fast response and if they feel they are not getting adequate cooperation they have the authority to issue fines and redirect site activities by issuing a notice of correction.

According to data for the third quarter of 2001, resource agencies issued 32 water quality penalties in Washington totaling $674,000 in fines. This number is up from 1998 when 50 were issued for the entire year for a total of $600,000. More commonly, resource agencies issue notices of correction requiring corrective actions, which typically exceed the costs associated with fines. There are potential benefits for saying and doing the right things during an inspection and the following survival tips are designed to do just that.

Tips for Surviving an Inspection

First impressions are important. It is important that everyone on the site know who the ESC Lead is so that they can direct the resource agency inspector to them. If the construction staff is unaware of whom the ESC Lead is a message is sent that no one on the site cares about erosion control. This can also cause the agency representative to

waste time and hurt the quality of any meeting to discuss alternative solutions to fines. When contacted by an agency representative, the ESC Lead should immediately contact the WSDOT Project Engineer, or one of the inspectors so that WSDOT, the contractor, and the resource agency can quickly resolve whatever problems prompted the visit to the site.

Note: Always keep a copy of the TESC plans on site – it's a permit requirement. Update them regularly. Write all over the TESC plans and don't worry about getting them dirty. A clean, unmarked plan sends the message that you have not been using it and that you don't care about erosion.

Resource agency representatives usually meet with WSDOT and the contractor to ask a series of questions and review background information. They will most likely request to see a copy of the NPDES permit and the current TESC or SPCC plans. WSDOT is required to have the permit and TESC plan on site and available to the agency. A project can be fined for not having them regardless of water quality conditions.

In addition, they may walk the site with the TESC/SPCC plan in hand to see if the plan is being implemented and maintained. WSDOT can be fined for not having current plans.

Resource agencies usually do not fine a project on the first visit. If the report that prompted the visit was unfounded, they may just leave. If there are minor problems, they may simply offer some technical assistance and take no formal action. If there are major problems four things may happen.

- On especially challenging sites where the owner and contractor are making a good faith effort to meet water quality standards, the resource agency may provide on-going technical assistance and take no formal enforcement action.
- Resource agencies often issue Notices of Correction. A Notice of Correction is a letter stating that a project is out of compliance and must install a specific set of standard BMPs before a certain deadline. If the conditions of the Notice of Correction are met, no further action is taken. If the Notice of Correction is not heeded, a fine will be issued.
- Resource agencies occasionally issue fines on the first visit if the violation is severe and the owner/contractor are uncooperative.
- If the person who violates the Clean Water Act does so with "willful intent", meaning that they clearly knew the law and intentionally violated it, the case may be turned over to the EPA and the offender may be criminally prosecuted. Criminal prosecution has occurred for intentional chemical spills, but has not occurred for turbidity standard violations.

Local Government Enforcement

Some WSDOT projects require permits from local governments for activities such as clearing and grading. Many of them have the authority to enforce stop work orders for non-complying sites. Inspections by local governments must be dealt with in the same manner as state and federal resource agencies as stated previously.

Conclusion

Take inspections seriously and treat the inspector(s) as if they were a client or customer, with respect and sincerity. Inspections are designed to help WSDOT and the contractor maintain compliance with environmental regulations. Notes should be taken and questions asked if things are not clear.

Maintaining one's cool is important at all times, regardless of the inspector's demeanor. They have a difficult job and they are obligated to enforce the laws passed by the citizenry. As the project owner, WSDOT project engineers and inspectors will resolve any disagreements.

Working together is important and any discussion to improve the situation is encouraged. In short, work with the inspector, not against—because our project depends on it.

Section 2

2.1 Definitions and Basic Principles of the Erosion/ Sedimentation Processes

2.1.1 Definitions

Erosion The process in which, by the actions of wind or water, soil particles are displaced and transported.

Sediment Eroded material suspended in water or wind

Sedimentation The deposition or settling of eroded material

Turbidity Having suspended solids, including sediment and organic matter in water (i.e., muddy).

2.2.2 Erosion Process by Water

Raindrop The impact of raindrops on bare soil displaces soil particles. Over the duration of a storm, significant volumes of sediment are made available to be transported.

Sheet As rain accumulates a non-concentrated, uniform layer of runoff is formed. This sheet flow transports detached soil from raindrop impacts, as well as plucks off additional soil particles caused by the shear stress of the runoff.

Rill When sheet flows converge, increased volumes and velocities of water are concentrated. Small, intermittent watercourses with steep sides, known as rills, are formed. They are usually only a few inches deep.

Gully When rills converge and/or impervious surfaces focus runoff in a single location, a large channel, known as a gully, is formed. Volumes and velocities of water, along with shear stress are increasing dramatically.

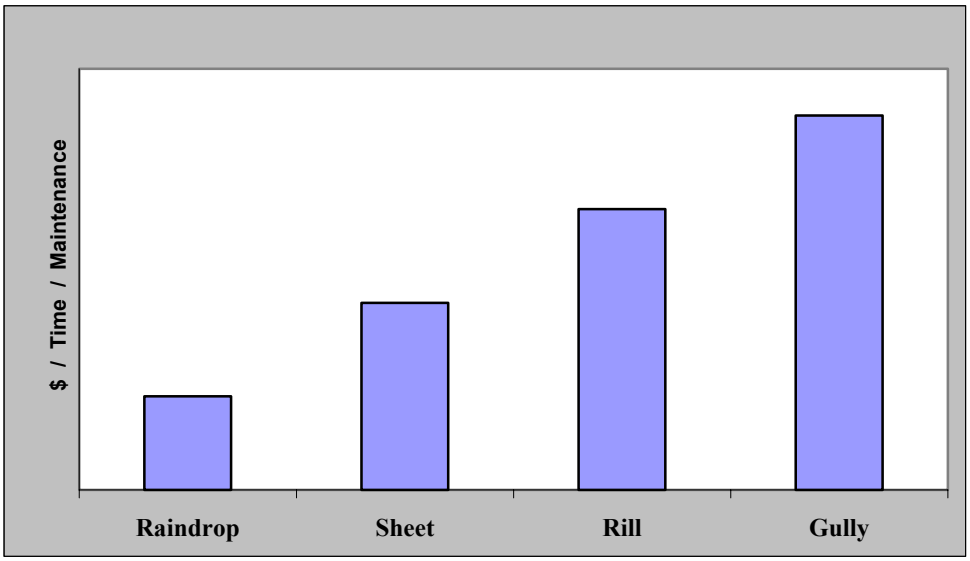
Stream Bank Bank erosion of existing streams/channels is caused by increased peak flows.

Erosion Process Influence On BMPs

The volumes and velocities of runoff at the raindrop and sheet flow phases are relatively low and as a result, they are often referred to as "low energy" phases. The rill and gully phases are often referred to as "high energy" because of the greater volumes and velocities. Therefore, if erosion control efforts are focused at the "low energy" phases,

less expensive BMPs can be used, less time will be spent implementing them, and less maintenance will be needed. The opposite is true if too much reliance is put on sediment control in place of prevention.

Figure 2.1.2 Erosion Process Influence On BMPs



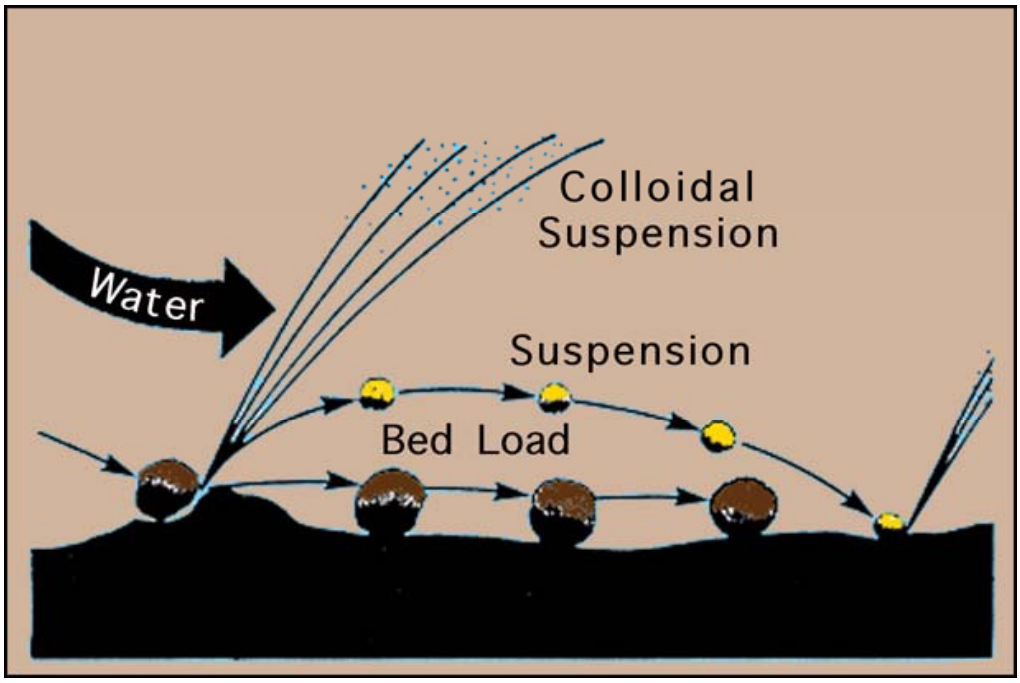
2.1.3 Sediment Movement by Water

Bed Load - Soil particles that are dragged, rolled, skipped, or saltated.

Suspension - Soil particles that are lifted up by the flow energy and moved long distances down stream before settling to the bed.

Colloidal Suspension - Same as suspension but includes only the fine, colloidal soil particles that may never settle to the bed.

Figure 2.1.3 Sediment Movement (Water)



2.1.4 Erosion Process by Wind

As is the case with water erosion, the loss of soil by wind movement involves the detachment and transportation processes. The lifting and abrasive action of the wind results in some detachment of tiny soil grains from the granules or clods of which they are a part. When the wind is laden with soil particles, however, its abrasive action is greatly increased. The impact of these rapidly moving grains dislodges other particles from soil clods and aggregates. These dislodged particles are now ready for movement.

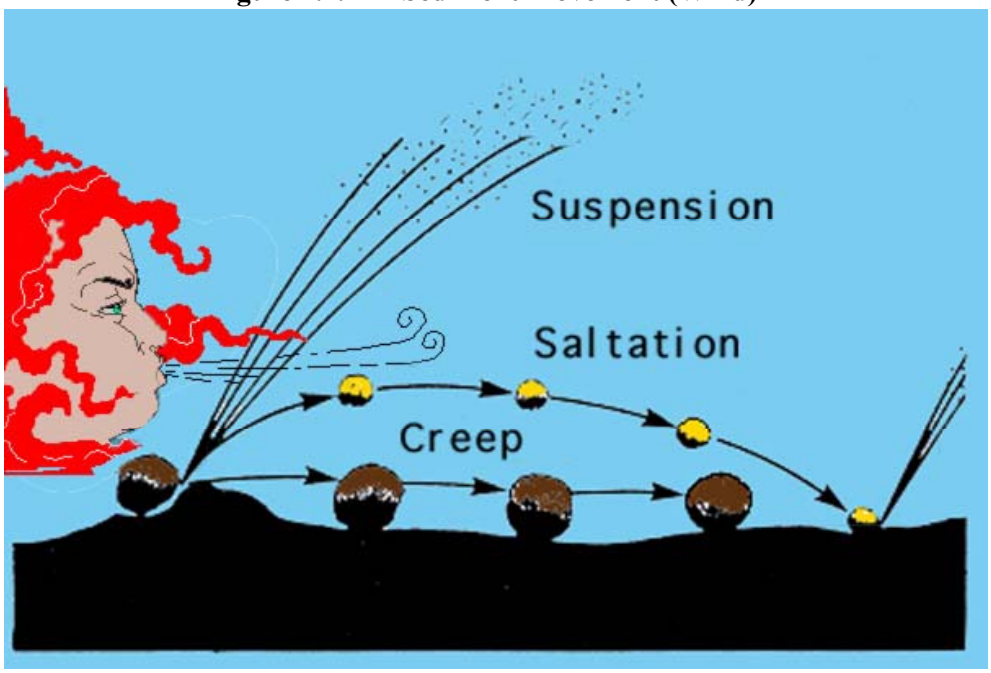
2.1.5 Sediment Movement by Wind

Saltation – The most important of the mechanics of wind erosion is saltation, defined by soil particles bouncing short distances. They remain close to the ground, usually no higher than twelve inches. Depending on soil conditions, saltation may account for 50-70% of total erosion.

Surface Creep – Saltation encourages surface creep, which is the rolling and sliding along the surface of larger soil particles. Not only is surface creep initiated by saltation, it is actually prolonged by the ricocheting action of saltating particles. Surface creep may account for 5-25% of total erosion.

Suspension – Dust particles of fine sand size or smaller are moved parallel and upward to the ground surface. Suspension can reach ten feet to many miles into the sky. Very fine particles are lifted from the surface by impact/saltation and carried high into the air, remaining suspended in air for long distances. Although it is a spectacular and visible method of transporting soil, it may account for only 15% of total erosion.

Figure 2.1.4 Sediment Movement (Wind)



2.2 Factors that Control Erodibility

- Soil
- Precipitation
- Vegetation
- Surface Area
- Slope Length & Gradient
- Surface Texture

Basin area, vegetation type, amount and type of precipitation, soil characteristics, gradient and slope length all contribute to the amount of soil lost to erosion. On any given site and project you will be able to control some of these factors, but not others. They can be compared to the knobs on a control panel and one of the first tasks of erosion control planning is to determine which knobs are adjustable.

For example, slope length and gradient can often be controlled through project design, or by terracing or otherwise breaking up a slope. Soil type is usually not controllable except when soil is imported for fill. Likewise, you can't change precipitation, but scheduling to avoid periods of high probability of rainfall provides some control over this factor. For any project and site consider the contribution each of these factors will make to potential erosion, and which of those you ca n control to reduce that potential.

2.2.1 Soil

Soil Texture

Soil contains varying combinations of sand, silt, and clay. The overall combination of these minerals is referred to as soil "texture." For example, a soil with 50% sand, 19% silt, and 31% clay is called a "sandy clay loam" (see soil triangle). Two important characteristics of texture are cohesion and infiltration.

Cohesion is the ability of soil particles to bind together. As it increases, erosion potential decreases. Sands are large, heavy particles that are loosely packed together. Silts consist of medium sized particles, which are moderately packed together. Clays are extremely small, tightly packed particles.

Infiltration is the ability for soil to absorb water and is a function of soil texture. Water infiltrates rapidly in coarse textured, highly porous soils such as sands, while fine textured soils like silt and clay will infiltrate little if any water. Groundwater seeps and mudslides are often found in association with fine textured soil due to limited infiltration in those layers.

Water and wind erosion are similarly affected by texture. Sands and silt are more susceptible due to less cohesion than the tightly packed clay particles.

Erosion Potential Evaluation Methods

The following methods are used to determine site-specific erosion potential based on soil texture. These include the following methods: (1) county soil surveys, (2) geotechnical report, (3) jar test in combination with soil triangle, and (4) hand texturing.

1. County Soil Survey

The Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service, has developed maps for Washington State that show the specific soil classification for any given location. These maps are compiled by county and are typically available from the regional NRCS office, local conservation district, or Washington State University Cooperative Extension office. To determine which soil group to use for an analysis, locate the project site on the NRCS map and read the soil classification that is listed. Section 2.3.1 of the Erosion Control Designers Course contains additional information to evaluate risks related to soils.

Hydrologic Soil Groups

Soil is categorized into four hydrologic soil groups to estimate stormwater runoff. Soils are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms. The four hydrologic soil groups are:

Group A
Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands.

Group B
Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well-drained soils that have moderately fine texture to moderately coarse texture.

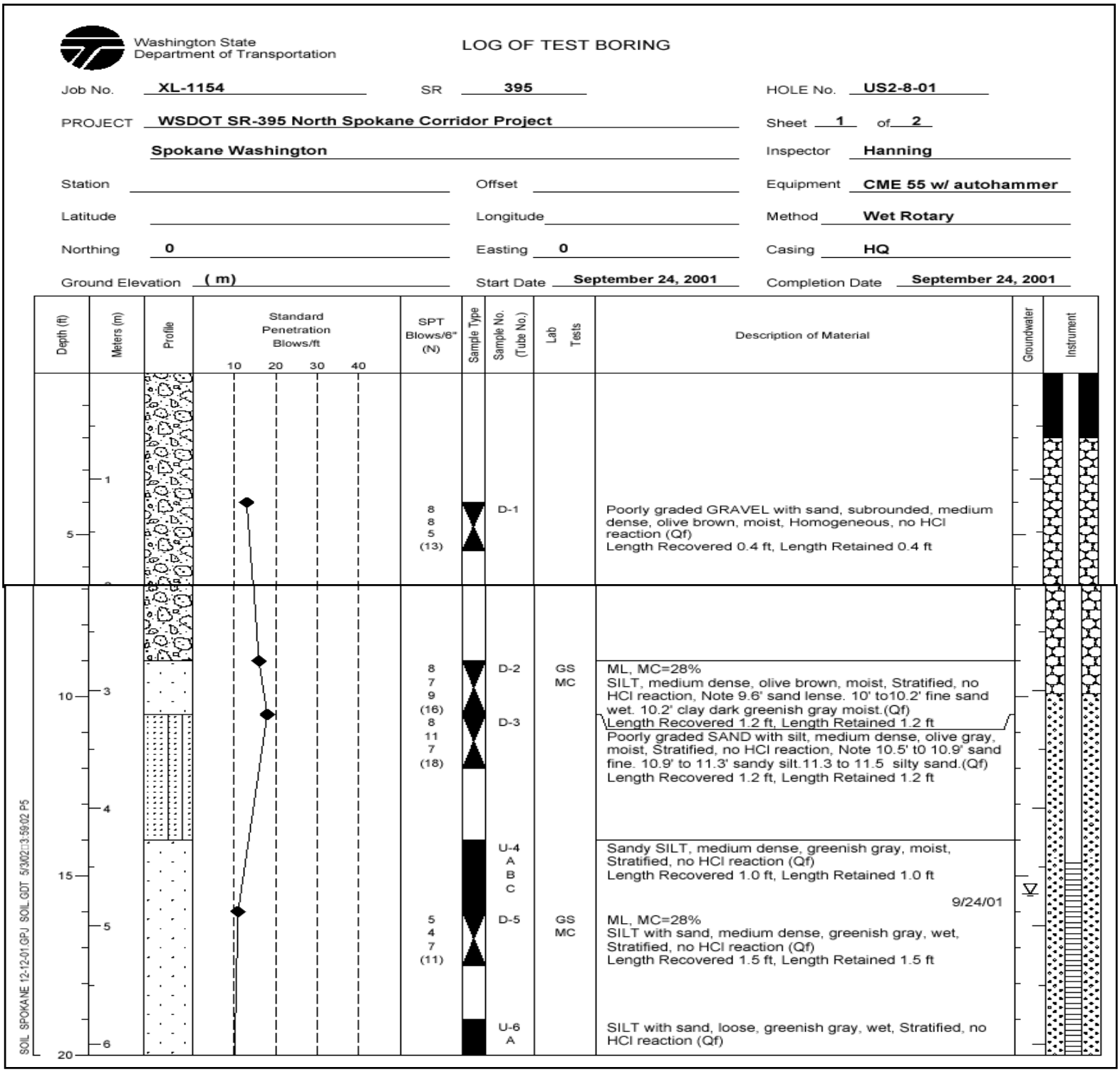
Group C
Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture.

Group D
Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material.

2. Geotechnical Reports

These usually give detailed descriptions of soils including soil grain size, which refers to the actual sizes of the individual particles (i.e., sand, silt, clay) making up the sediment portion of the soils. The grain size distribution of a given sample of sediment or soil is most often reported as a series of percentages (for each size class) of the overall sample mass or weight. Knowing the grain size and structure can lead to understanding the porosity of the soil and its ability to hold moisture.

Figure 2.2.1 Log of Test Boring



Washington State Department of Transportation

LOG OF TEST BORING

Job No. XL-1154 SR 395 HOLE No. US2-8-01

PROJECT WSDOT SR-395 North Spokane Corridor Project Sheet 1 of 2

Spokane Washington Inspector Hanning

Station Offset Equipment CME 55 w/ autohammer

Latitude Longitude Method Wet Rotary

Northing 0 Easting 0 Casing HQ

Ground Elevation (m) Start Date September 24, 2001 Completion Date September 24, 2001

Depth (ft)	Meters (m)	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1		8 8 5 (13)		D-1		Poorly graded GRAVEL with sand, subrounded, medium dense, olive brown, moist, Homogeneous, no HCl reaction (Qf) Length Recovered 0.4 ft, Length Retained 0.4 ft		
10	3		8 7 9 (16)		D-2	GS MC	ML, MC=28% SILT, medium dense, olive brown, moist, Stratified, no HCl reaction, Note 9.6' sand lense. 10' to10.2' fine sand wet. 10.2' clay dark greenish gray moist.(Qf) Length Recovered 1.2 ft, Length Retained 1.2 ft		
			8 11 7 (18)		D-3		Poorly graded SAND with silt, medium dense, olive gray, moist, Stratified, no HCl reaction, Note 10.5' t0 10.9' sand fine. 10.9' to 11.3' sandy silt.11.3 to 11.5 silty sand.(Qf) Length Recovered 1.2 ft, Length Retained 1.2 ft		
15	4				U-4 A B C		Sandy SILT, medium dense, greenish gray, moist, Stratified, no HCl reaction (Qf) Length Recovered 1.0 ft, Length Retained 1.0 ft	9/24/01	
	5		5 4 7 (11)		D-5	GS MC	ML, MC=28% SILT with sand, medium dense, greenish gray, wet, Stratified, no HCl reaction (Qf) Length Recovered 1.5 ft, Length Retained 1.5 ft		
20	6				U-6 A		SILT with sand, loose, greenish gray, wet, Stratified, no HCl reaction (Qf)		

SOIL SPOKANE 12-12-01.GPJ SOIL.GDT 5/3/02□3:59:02 P5

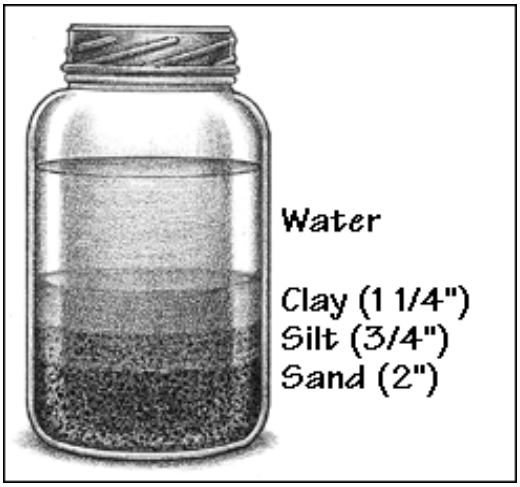
3. Jar Test/Soil Triangle

One way to determine soil texture in the field involves using a jar and soil triangle. This method involves the following steps.

Step 1

Fill a quart jar with equal parts of soil and water; shake vigorously, then let it stand. The largest particles (sand) will settle out in about a minute. Silt will take about an hour, while clay may take all day. Measure the depth of each layer, and divide by the total depth of the soil to get a percentage for each component.

Figure 2.2.1A Jar Test



Example			**To Find Percentages**
Total depth	=	4 inches	
Sand layer	=	2 inches	Sand: 2 divided by 4 = 0.50, or 50%
Silt layer	=	¾ inch	Silt: 3/4 divided by 4 = 0.19, or 19%
Clay layer	=	$1^{1}/_{4}$ inches	Clay: 1.25 divided by 4 = 0.31 or 31%

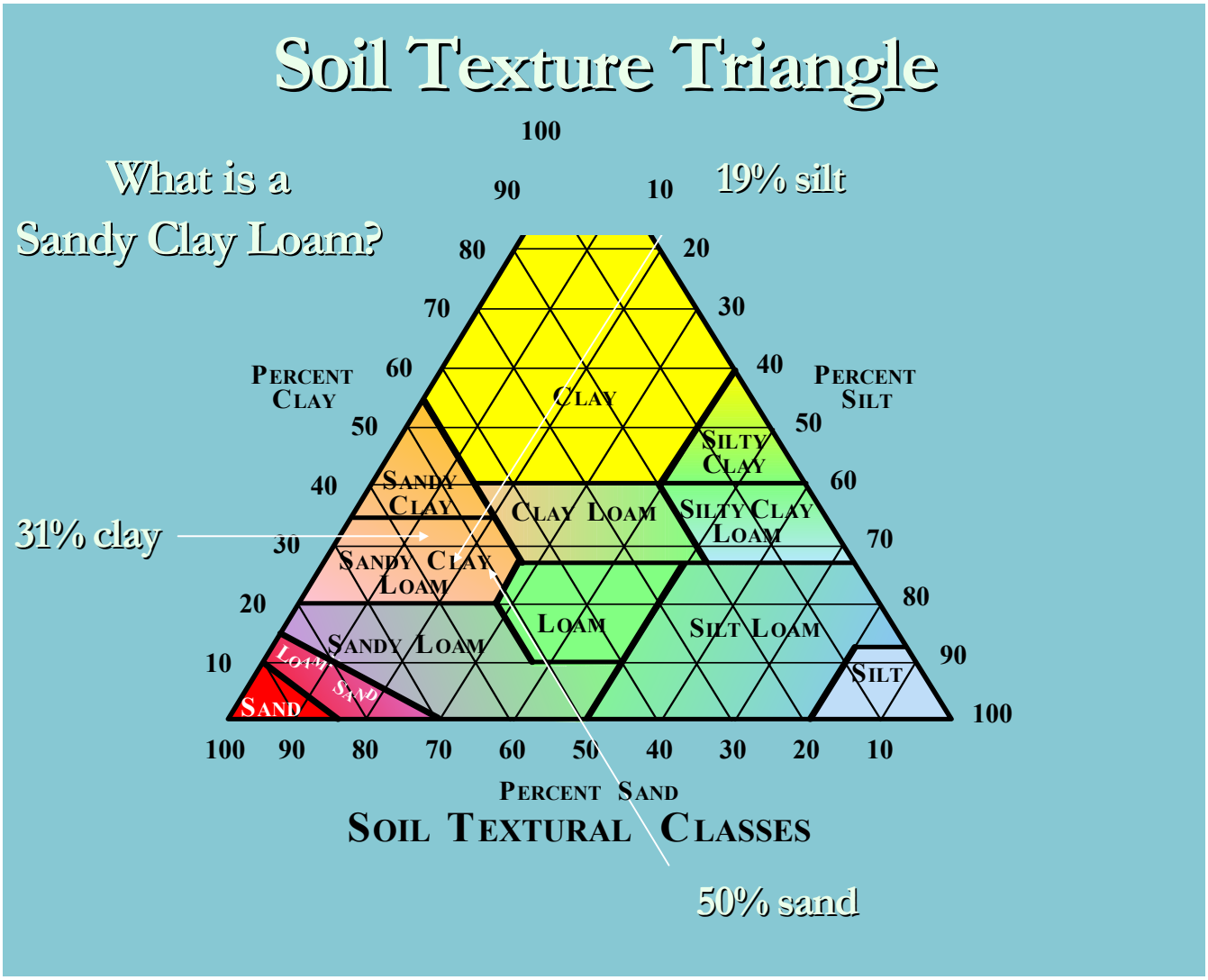
Step 2

Plot the results of your soil test on the soil-texture triangle. Draw a line from each scale (clay, silt, or sand) that starts at the approximate percentage and runs parallel to the triangle side at the 0% end of the scale. In the example shown here, lines from 31% on the clay scale, 19% on the silt scale, and 50% on the sand scale meet to identify the soil as "sandy clay loam."

Example

- 50% Sand
- 19% Silt
- 31% Clay = Sandy Clay Loam

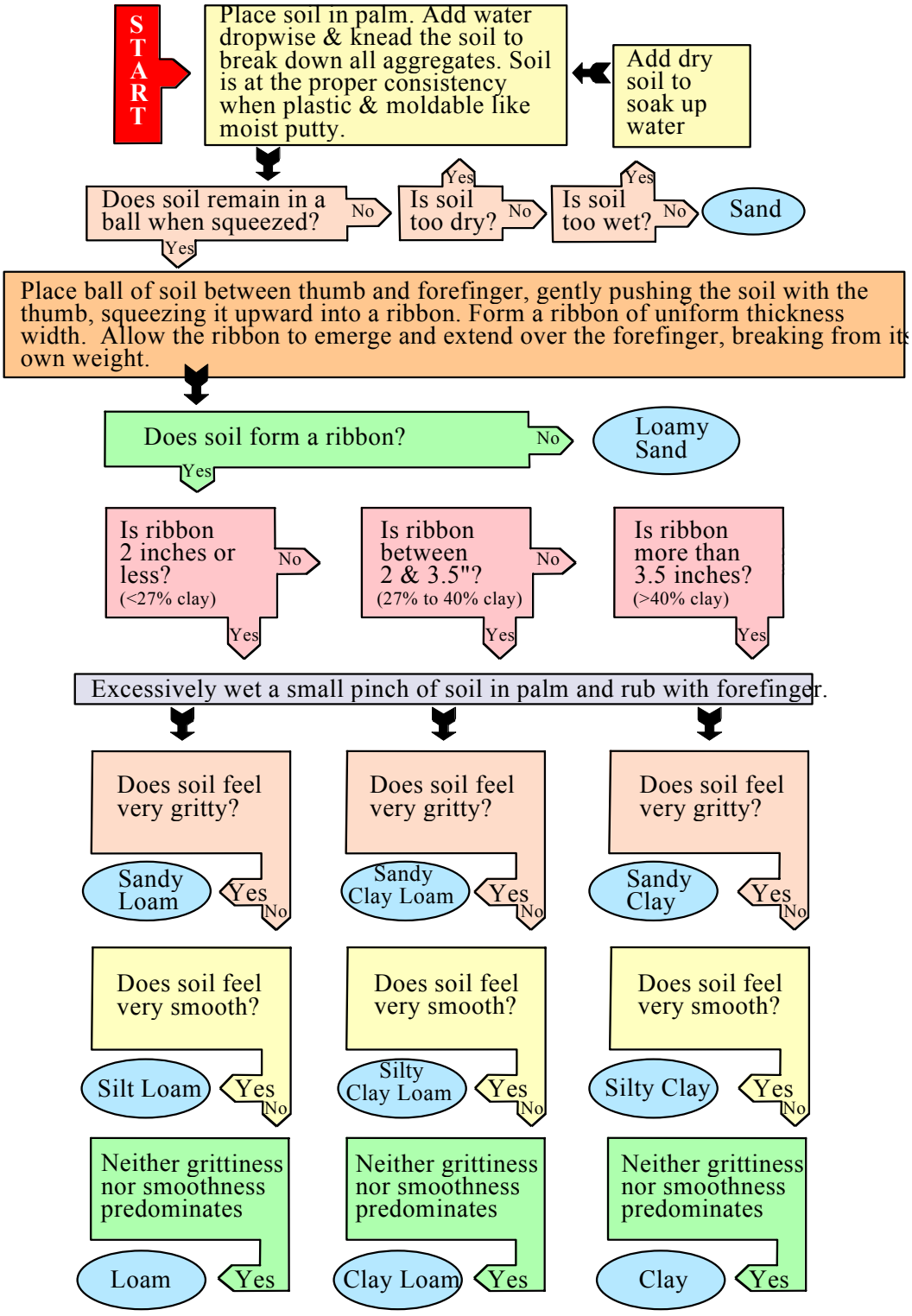
Figure 2.2.1B Soil Texture Triangle



4. Hand Texturing

Another field sampling method to determine soil texture is hand texturing. For this method, a representative soil sample is rolled into a ball and the flow chart provided on the next page is followed. While not as precise as some of the other methods mentioned above, hand texturing can give a rough estimate of a soils texture and how that soil might affect erosion.

Figure 2.2.1C Hand Texturing



Influence of Soil Texture On Turbidity

Soil texture greatly influences the turbidity of construction runoff. The rate at which eroded soil particles settle out of solution as sediment is largely determined by the size of the particle. Larger particles weigh more and settle faster, whereas, smaller particles weigh less and settle more slowly. Extremely small particles form colloidal suspensions that do not settle out for years or centuries. Settling rates for a wide range of soil particle sizes is indicated on Table 2.2.1A.

Table 2.2.1A Settling Velocities Of Soil Particles In Still Water

Diameter of Particle (mm)	Order of Size	Settling Velocity (mm/sec)	Time Required to Settle One Meter (3.28 Ft)
10.0	Gravel	1.000	1.0 Seconds
1.0		100	9.8 Seconds
0.6	Coarse Sand	63	15.0 Seconds
0.3		32	30.0 seconds
0.15	Fine Sand	15	67.0 Seconds
0.015		0.35	47.6 Minutes
0.010	Silt	0.154	107.0 Minutes
0.003		0.0138	20.1 Hours
0.0015	Clay	0.0035	79.0 Hours
0.001		0.00154	180.0 Hours
0.0001		0.0000154	754.0 Days
0.00001	Colloidal Particles	0.000000154	207.0 Years
NOTE: Temperature 50°C; all particles assumed to have a specific gravity of 2.65.			

Fine textured soils contain a high proportion of small soil particles that, once suspended, create turbid runoff that requires long settling times to clarify. Such runoff is very difficult to clarify using standard sediment control BMPs.

Coarse, sandy soils are easily eroded, but suspended particles rapidly settle due to their larger size. Therefore, sites with sandy soils may experience severe erosion yet have low turbidity runoffs, especially when effective sedimentation control BMPs are used.

2.2.2 Precipitation

The frequency, intensity and duration of precipitation events affect erosion potential. It is important to know the precipitation patterns when preparing and implementing TESC plans. Knowing one rainfall variable alone is insufficient. All three factors must be evaluated to accurately assess the potential for erosion. Seasonal variations for each of these factors must also be considered.

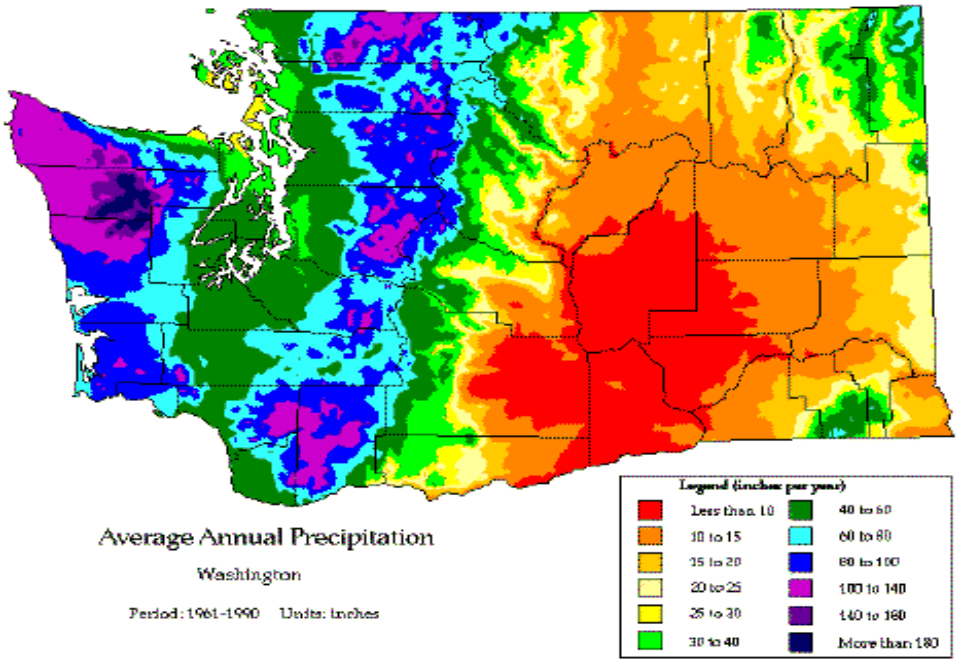
Frequency - Higher frequency precipitation events may expose a site to greater potential for erosion because of its influence on saturation within the soil. Once the soil is saturated it takes less precipitation to cause erosion since more is flowing on top of the soil surface rather than infiltrating.

Intensity - High intensity rainfall events have the greatest potential for erosion for two reasons. First, high intensity rainfall events cause the most severe raindrop erosion. Secondly, high intensity rainfall events create flashy, large runoff volumes. This runoff usually collects as high energy, concentrated flow that can cause rills, gullies, and damage to drainage features.

Duration - Duration of precipitation events also affects the potential for erosion because of the ability to saturate to soil. Saturated soil conditions increase the potential for both increased surface runoff volumes and mudslides. A given amount of rainfall at the end of prolonged rain event often does much greater damage than the same amount of rain at the beginning of the rain event.

Moisture content of the soil is critical when determining its susceptibility to wind erosion. Figure 2.2.2A illustrates how dust control issues may vary around the state.

Figure 2.2.2A Average Annual Precipitation



Available Rainfall Data on the Internet

Knowing the expected rainfall for any given area and time of year can be critical. Forecasts provide an idea of the weather for the next few days, but statistical data, based on past rainfall records, is needed to help identify long-term trends.

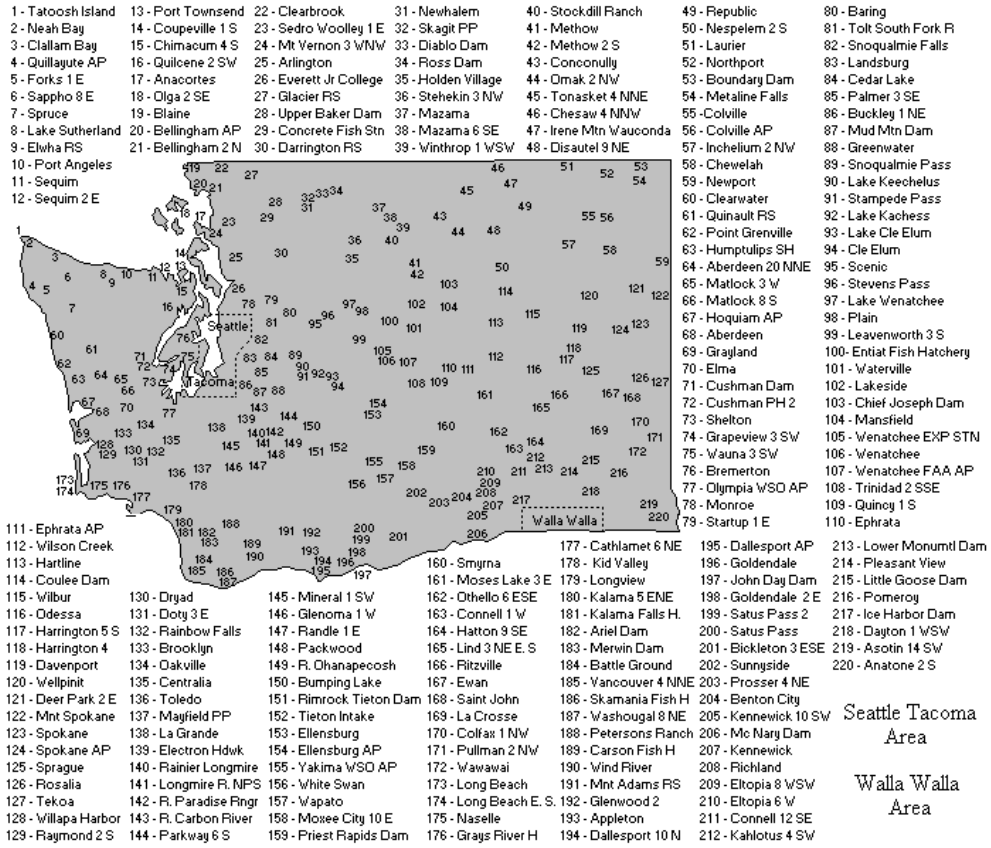
The Western Regional Climate Center has statistical information on precipitation, temperature, and several other measurements available on their web site. Included on their site is tabular and graphical information as well as interactive probability graphing capabilities.

Of particular interest to WSDOT designers, inspectors, and project managers are the Average Total Monthly Precipitation graphs. These graphs are available for over 200 sampling stations throughout the state and can be copied and pasted into Stormwater Site Plans, Temporary Erosion and Sediment Control Plans, Water Quality Monitoring plans, and other documents that address stormwater and its potential for impacts on the environment.

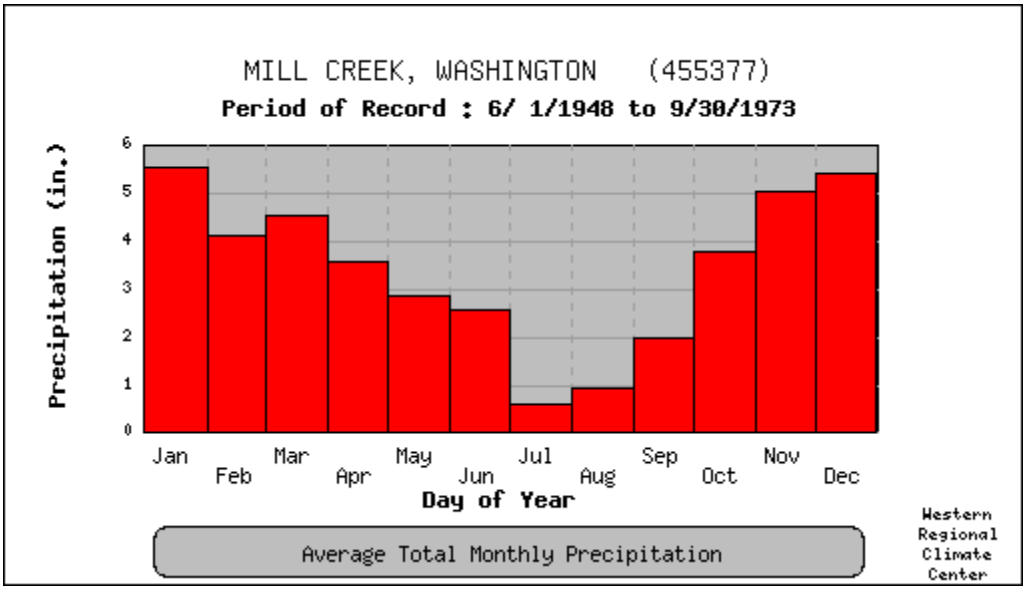
The address for the Western Regional Climate Center summaries is: http://www.wrcc.dri.edu/summary/climsmwa.html.

At this address an alphabetical list of all the sampling stations is available in the left frame and an interactive map (Figure 2.2.2B) showing their locations in the right frame. Linking to a station by clicking on the list name or on the map location is available.

Figure 2.2.2B Washington State Rain Gauge Stations

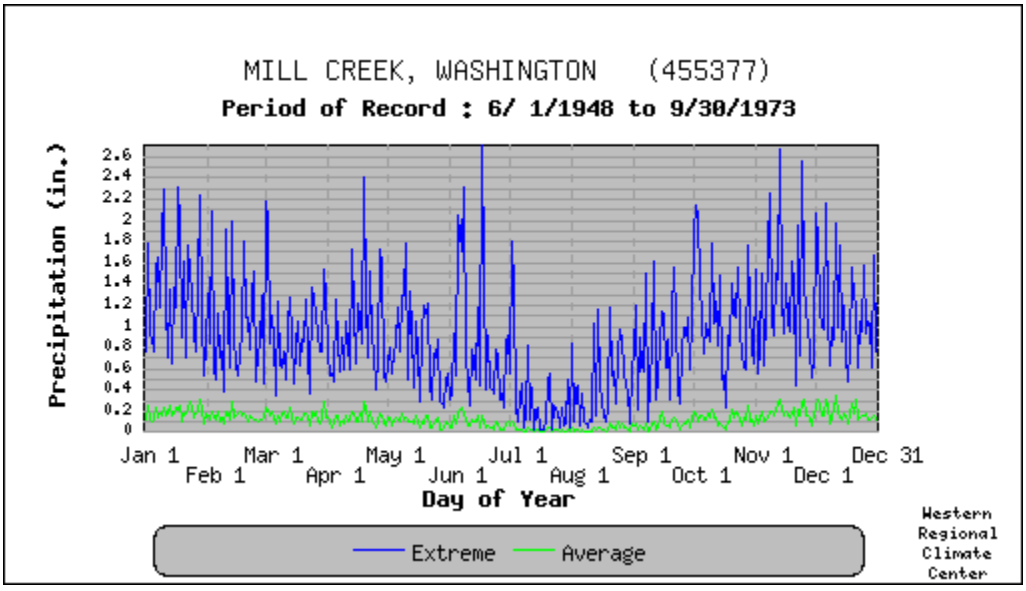


The following example has been selected to demonstrate the graphing capabilities of this website.

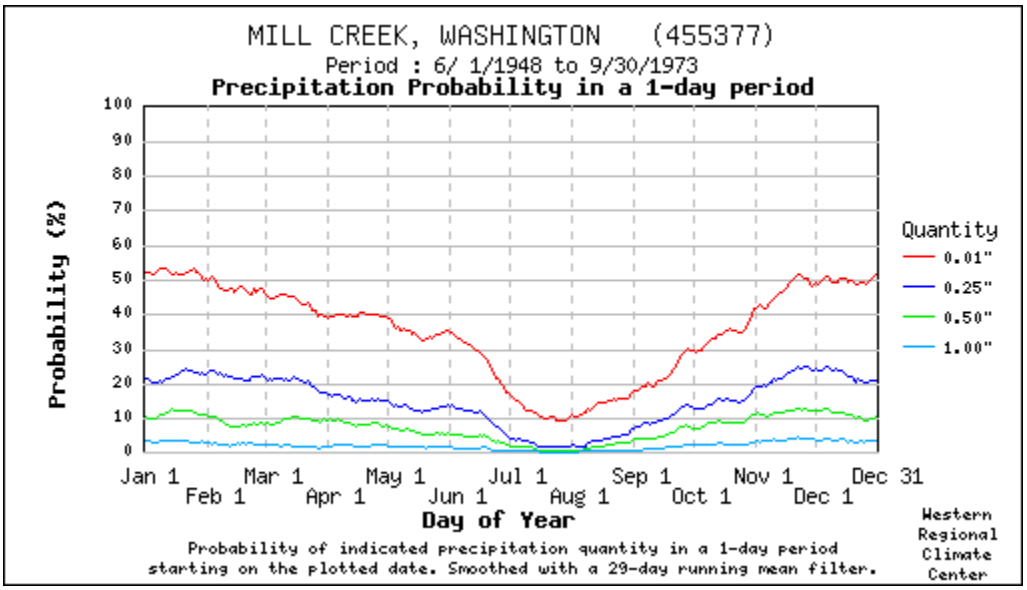


Average monthly totals give a good starting point to determine how projects should be phased and at what times of year the site should be most heavily protected.

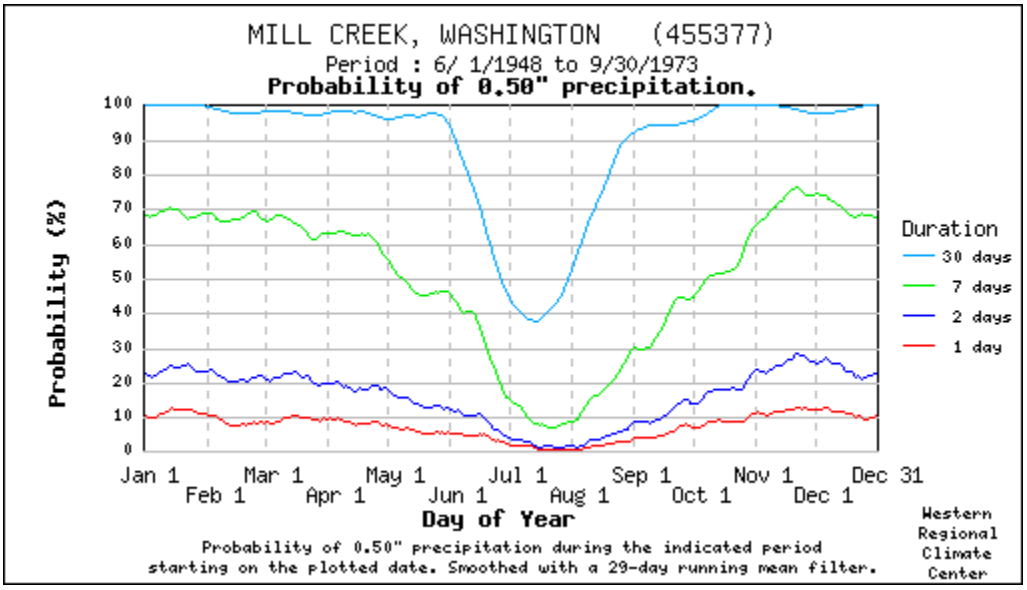
Extreme events, not averages, are responsible for severe erosion problems. Note that the frequency of extreme events is highest during the wet season, yet extreme events happen throughout the year.



The probability of extreme events (any rainfall quantity) can be checked for risk assessment during construction.



The risk of erosion increases with the duration of time that soils are exposed. Tables can be made to asses risk with any rainfall amount over any given time period. Note how the 2-day soil cover requirement keeps the risk of exposed soils from getting hit with 0.5 inches of rain to 20-30% in the wet season. Soils left uncovered for 7 days in the wet season (especially the fall) have a 50-75% probability of getting hit with enough rain to cause serious erosion. Soils exposed for a month in the wet season are virtually guaranteed (>95-100% chance) of getting hit with a ½-inch storm event.



2.2.3 Vegetation

Runoff Volume

Well-vegetated areas experience little erosion. Rain is intercepted by the tree canopy and evaporates back into the atmosphere. The canopy also decreases the evaporation of water from the soil, making it less susceptible to wind erosion. Plant roots increase the porosity of soils increasing infiltration rates. Forest floor material such as moss, pine needles, twigs, dead grass, and rotten wood absorb water and decreases ground level wind speeds.

Flow Velocity

The velocity of stormwater runoff slows down due to surface friction created by vegetation and other material on the forest floor.

Sediment Filtration

Vegetation and litter (dead plants) serve as natural filters, catching suspended materials in runoff.

Energy Absorption

Vegetation and litter absorb the energy of falling raindrops, reducing raindrop erosion. Roots, vegetation and litter break up flows reducing runoff energy below levels that cause erosion.

Soil Retention

Roots bind soils, while vegetation and litter trap most dislodged soil particles. Grass roots make up 50% of the plant mass.

2.2.4 Surface Area

There are two ways that large surface areas affect soil erodibility. First, they collect large volumes of water and the concentrated flows can be quite damaging. Second, the available supply of fugitive dust particles is increased. As a result of this problem with surface area, WSDOT has created standard specification 8-01.1, which limits acreage exposure based on time of year and location within Washington (Eastern/Western).

2.2.5 Slope Length & Gradient

Doubling the slope length increases the potential for water erosion four times and doubling the slope gradient increases the potential five times. With increased slope lengths and gradients, runoff travels faster with more erosive energy. Higher velocity runoff more rapidly form rills and gullies that concentrate erosive flows and energy even further.

2.2.6 Surface Texture

Increased surface texture decreases soil erosion by slowing runoff velocities and decreasing ground level wind speeds. Increased texture encourages infiltration of stormwater and reduces saltation and surface creep of wind blown soil particles.

2.3 Influence of Hydrologic Soil Group and Land Use on Stormwater Runoff Rates

The NRCS has studied the runoff characteristics of various land uses. After gathering and analyzing extensive data, they developed relationships between land use, soil group, vegetation cover, interception, infiltration, surface storage, and runoff. The relationships have been characterized by a single runoff coefficient called a curve number (CN).

The hydrologic soil group and land use impact runoff rates, which in turn affect erosion potential. Higher runoff rates generate concentrated, high-energy flows that can cause severe erosion. Except in highly developed areas with large areas of impervious surfaces, the hydrologic soils group can often be the most important factor influencing runoff rates. It is important, therefore, to consider hydrologic soils groups when sizing TESC conveyances and detention facilities. Table 2.2.1B shows suggested CN values for various land uses and soils.

Table 2.2.1B Runoff Curve Numbers by Hydraulic Soil Group and Land Use

Land Use	Hydraulic Soil Group			
	A	B	C	D
Mountain brush, oak brush, aspen, maple	0.40	0.48	0.57	0.63
Woods or forest land	0.40	0.60	0.73	0.79
Woods/Grass combination (orchard/tree farm)	0.43	0.65	0.76	0.82
Brush with weeds and grass	0.40	0.56	0.70	0.77
Meadow continuous grass	0.40	0.58	0.71	0.78
Residential districts: ¼ acre lots	0.61	0.75	0.83	0.87
1 acre lots	0.51	0.68	0.79	0.84
Pasture or range	0.49	0.69	0.79	0.84
Newly graded areas (no vegetation established)	0.77	0.86	0.91	0.94
Lawns, parks, golf courses, cemeteries	0.49	0.69	0.79	0.84
Gravel roads and parking lots	0.88	0.92	0.95	0.98
Impervious surfaces: pavement and roofs	0.98	0.98	0.98	0.98
Open water bodies: lakes, wetlands, and ponds	1.00	1.00	1.00	1.00

Calculating Runoff

Methods exist that allow stormwater runoff volumes to be calculated from a given area. One such method is the Rational Method Equation, which is outlined below:

Q = C x I x A where:
- Q = Runoff rate in cubic feet/hour
- C = Curve number: based on surface and cover
- I = Precipitation intensity in feet/hour
- A = Surface area in square feet

The above factors must be acquired from indexes for a given area. To learn more about the runoff equation or other equations, refer to the *Highway Runoff Manual* (http://www.wsdot.wa.gov/fase/EngineeringPublications/Manuals/Highway.pdf) or contact the NRCS website at http://www.nrcs.usda.gov.

2.3.1 Sample Calculations

The following samples reveal how specific factors influence stormwater runoff volumes and thus, erosion potential. Let's take a one-acre wooded site having a Group "C" soil that will be converted to a highway rest stop. Using the Rational Method Equation, a site with the above characteristics would produce the following average volumes of water from a one-inch (.08 feet) storm event over a one-hour period.

Construction Site Condition	Area (square feet)	Rainfall (feet/hour)	Curve Number	Avg. Runoff (cubic feet/hour)	Avg. Runoff (gallon/minute)
RATIONAL METHOD Q=CIA	**A**	**I**	**C**		**Q**
Pre-development/Woods	43,560	0.08	0.73	2544	318
Newly Graded/Group "C"	43,560	0.08	0.91	3171	396
Post Development/Grass	43,560	0.08	0.79	2753	344
Asphalt As A Comparison	43,560	0.08	0.98	3415	427

The chart below reveals how runoff volumes will vary for the same site if other soil groups (A, B, C, D) are present. In this example, the soil is newly graded.

Construction Site Condition	Area	Rainfall et/hour)	Curv Numb	Av of (cubic feet/hour)	Avg. Runoff (gallon/minute)
RATIONAL METHOD Q=CIA		**I**	**C**		**Q**
Pre-development/Woods	43,560	0.08	0.73	2544	318
Group "A"/Sand	43,560	0.08	0.77	2,683	335
Group "B"/Loam	43,560	0.08	0.86	2,997	375
Group "C"/Till	43,560	0.08	0.91	3,171	396
Group "D"/Clay	43,560	0.08	0.94	3,276	410

Section 3

3.1 Introduction – Best Management Practices

This section covers Best Management Practices (BMP's) employed to prevent or reduce erosion on a construction site. There are three levels of BMP's including 1) design, 2) procedural, and 3) physical. Design and procedural BMP definitions and examples are covered in section 4 of this manual. Section 3 covers all of the physical BMP's.

Physical BMP's are organized into two parts; erosion control (preventing soil detachment) and sediment control (trapping detached soil particles). Temporary and permanent cover using natural or simulated vegetation are examples of source control BMP's. That is, they prevent erosion from happening in the first place. However, even the best efforts at preventing erosion are usually not 100% effective, particularly during big rain events. Sediment control BMP's such as silt fence work to remove as much sediment as possible from runoff before it leaves the site.

Properly installed erosion control BMP's improve the performance of sediment control efforts. However, solely relying on erosion control BMP's is inadequate. In addition, solely relying on sediment control without performing any erosion control will overwhelm the BMP's.

Many structural erosion control BMP's do not actually cover bare soil per se, but prevent further erosion by preventing existing runoff from accessing the soil. Other structural control BMP's prevent site conditions from getting worse as a result of construction activities.

All prefabricated erosion and sediment control BMPs must be approved prior to use on WSDOT projects. The Qualified Products Lists (QPL) contains many pre-approved products to choose from. Manufacturers of products must submit an application with specific product information to WSDOT's New Products Committee for review. Applications can be submitted online to the New Products Committee and the QPL can be viewed at the following website: http://www.wsdot.wa.gov/biz/mats/QPL/QPl.cfm

3.2 Temporary Cover

3.2.1 Temporary Seeding

Definition

The establishment of a temporary vegetative cover on disturbed areas by seeding with plants. Temporary soil stabilization is provided to areas that remain bare where permanent cover is not necessary or appropriate.

Purpose

A well-established vegetative cover is one of the most effective methods of reducing erosion by protecting bare soil from raindrop impact and binding the soil with its roots.

WSDOT Specification

2004 Standard Specifications
8-01.3(2) Temporary Seeding, Mulching, and Soil Binding

8-01.3(2)A Temporary Seeding
Temporary seeding is used to establish temporary cover on disturbed soil. Temporary seeding shall be in accordance with Section 8-02.

8-01.3(2)B Temporary Mulching
Temporary mulch, such as straw, wood cellulose (with and without tackifier), compost, or other best management practices as approved by the Engineer, may be applied at any time of the year for soil cover. Temporary mulching shall be in accordance with Section 8-02.3(15).

8-02.3(15)A Preparation For Final Application
Areas to be cultivated are shown in the Plans or specified in the Special Provisions. The areas shall be cultivated to the depths specified to provide a reasonably firm but friable seedbed. Cultivation shall take place no sooner than two weeks prior to seeding. All areas to be seeded, including excavated slopes shall be compacted and prepared unless otherwise specified or ordered by the Engineer. Unless seed is covered with soil immediately after seed application, a cleated roller, crawler tractor, or similar equipment, approved by the Engineer that forms longitudinal depressions at least 2 inches deep shall be used for compaction and preparation of the surface to be seeded. The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope unless otherwise approved by the Engineer. The soil shall be conditioned with sufficient water so the longitudinal depressions remain in the soil surface until completion of the seeding. The area shall be compacted within three weeks prior to

seeding. Prior to seeding, the finished grade of the soil shall be 1 inch, or the specified depth of mulch, below the top of all curbs, catch basins, junction and valve boxes, walks, driveways, and other structures.

8-02.3(15)B Seeding and Fertilizing
Seed and fertilizer shall be placed at the rate, mix and analysis specified in the Special Provisions or as designated by the Engineer. The Contractor shall notify the Engineer not less than 24 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved. Following the Engineer's approval, seeding of the approved slopes shall begin immediately. Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable. Seed and fertilizer may be sown by one of the following methods:

1. An approved hydro seeder that utilizes water as the carrying agent, and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into a homogeneous slurry the specified amount of seed and water or other material. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles that will provide a uniform distribution of the slurry.

2. Approved blower equipment with an adjustable disseminating device capable of maintaining a constant, measured rate of material discharge that will ensure an even distribution of seed at the rates specified.

3. Helicopters properly equipped for aerial seeding.

4. Approved power-drawn drills or seeders.

5. Areas in which the above methods are impractical may be seeded by approved hand methods. When seeding by hand, the seed shall be incorporated into the top 1/4 inch of soil by hand raking or other method that is approved by the Engineer. The seed shall have a tracer added to visibly aid uniform application. This tracer shall not be harmful to plant and animal life. If wood cellulose fiber is used as a tracer, the application rate shall not exceed 250 pounds per acre. Hand seeding operations are excluded from this requirement. Seed and fertilizer may be applied in one application provided that the fertilizer is placed in the hydro seeder tank no more than one hour prior to application.

8-02.3(15)C Liming
Agricultural lime shall be applied at the rates specified in the Special Provisions. The method of application shall be in conformance with all air and water pollution regulations and shall be approved by the Engineer.

8-02.3(15)D Mulching
Mulch of the type specified in the Special Provisions shall be furnished, hauled, and evenly applied at the rates indicated and shall be spread on seeded areas within 48 hours after seeding unless otherwise specified. Distribution of straw mulch material shall be by means of an approved mulch spreader that utilizes forced air to blow mulch material on seeded areas. In spreading straw mulch, the spreader shall not cut or break the straw into short stalks. Wood cellulose fiber may be applied with seed and fertilizer West of the summit of the Cascade Range. East of the summit of the Cascade Range, seed and fertilizer shall be applied in one application followed by the application of wood cellulose fiber. Wood cellulose fiber used as mulch shall be suitable for application with a hydro seeder as specified in Section 8-02.3(15)B. Areas not accessible by mulching equipment shall be mulched by approved hand methods. Mulch sprayed on signs or sign structures shall be removed the same day.

8-02.3(15)E Soil Binder or Tacking Agent
When the proposal includes a pay item for soil binders and tacking agents, they shall be applied in accordance with the manufacturer's recommended requirements. Tackifiers used as a tie-down for seed and mulch shall be applied in quantities sufficient to equal the retention properties of guar when applied at the rate of 60 pounds per acre.

8-02.3(15)F Dates for Application of Final Seed, Fertilizer, and Mulch
Unless otherwise approved by the Engineer, the final application of seeding, fertilizing, and mulching of slopes shall be performed during the following periods:

West of the summit of the Cascade Range - March 1 to May 15 and August 15 to October 1. Where contract timing is appropriate, seeding, fertilizing, and mulching shall be accomplished during the fall period listed above. Written permission to seed after October 1 will only be given when physical completion of the project is imminent and the environmental conditions are conducive to satisfactory growth.

East of the summit of the Cascade Range - October 1 to November 15. Seeding, fertilizing, and mulching shall be accomplished during this fall period only.

8-02.3(15)G Protection and Care of Seeded Areas
In addition to the requirements of Section 1-07.13(1), the contractor shall be responsible for performing the following duties:

1. Protect all areas involved against vehicle and pedestrian traffic by use of approved warning signs and barricades.

2. Areas, which have been damaged through any cause prior to final inspection, and areas failing to receive a uniform application at the specified rate, shall be reseeded, refertilized, and remulched at the Contractor's expense.

3. Seeded areas within the planting area shall be considered part of the planting area. Weeds within the seeded areas shall be controlled in accordance with Section 8-02.3(3).

Additional Information

ROADSIDE SEED MIXES

The following seed mixes are proven performers on Washington State roadsides. (Seed mixes used for both temporary and permanent seeding)

Table 3.1.1A Seed Mixes - Western Washington

More Than 20 Inches of Precipitation

Seed Type	% By Weight
Red or Creeping Fescue	80
Colonial Bentgrass	20

Less Than 20 Inches of Precipitation

Seed Type	% By Weight
Sherman Big Bluegrass	40
Hard Fescue or Sheep Fescue	60

Mountain

Seed Type	% By Weight
Hard Fescue or Sheep Fescue	25
Orchardgrass 'Paiute'	25
Mountain Brome	50

Eastern Washington

Less than 20 inches of Precipitation

Seed Type	% By Weight
Western Wheatgrass	25
Sherman Big Bluegrass	25
Hard Fescue or Sheep Fescue	25
Intermediate Wheatgrass	25

Table 3.1.1B Native Erosion Control Grass Mixtures for Eastern Washington

The following seed mixes are often required for areas requiring all native species, species that don't compete with agricultural crops, or species that are adapted to specific soils i.e., sand or wetlands.		
12" RAINFALL OR LESS: AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	20
Bluebunch Wheatgrass	Agropyron spicatum	20
Sandberg Bluegrass	Poa sandbergii	20
Big Bluegrass	Poa ampla	20
Idaho Fescue	Festuca idahoensis	20
12" RAINFALL OR LESS: NON-AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	20
Bluebunch Wheatgrass	Agropyron spicatum	20
Great Basin Wildrye	Elymus cinereus	10
Sandberg Bluegrass	Poa sandbergii	10
Big Bluegrass	Poa ampla	20
Idaho Fescue	Festuca idahoensis	19.5
Tailcup Lupine	Lupinus caudatus	0.5
12" RAINFALL OR LESS SANDY SOIL PROBLEM AREAS		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	20
Streambank Wheatgrass	Agropyron spicatum	19.5
Indian Ricegrass	Oryzopsis hymenoides	15
Snake River Wheatgrass	Elymus lanceolatus wawawai	15
Needle and Thread	Stipa comata	15
Sand dropseed	Sporobolus cryptandrus	15
Tailcup Lupine	Lupinus caudatus	0.5
12" to 15" RAINFALL: AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	15
Streambank Wheatgrass	Agropyron riparium	15
Canby Bluegrass	Poa canbyi	15
Bluebunch Wheatgrass	Agropyron spicatum	20
Idaho Fescue	Festuca idahoensis	20
Prairie Junegrass	Koeleria pyramidata	15

12" to 15" RAINFALL: NON-AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	15
Streambank Wheatgrass	Agropyron riparium	15
Canby Bluegrass	Poa canbyi	15
Bluebunch Wheatgrass	Agropyron spicatum	20
Idaho Fescue	Festuca idahoensis	19.5
Prairie Junegrass	Koeleria pyramidata	15
Tailcup Lupine	Lupinus caudatus	0.5
12" to 15" RAINFALL: SANDY SOIL PROBLEM AREAS		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	20
Streambank Wheatgrass	Agropyron riparium	19.5
Indian Ricegrass	Oryzopsis hymenoides	15
Snake River Wheatgrass	Elymus lanceolatus	15
Needle and Thread	Stipa comata	15
Sand dropseed	Sporobolus cryptandrus	15
Tailcup Lupine	Lupinus caudatus	0.5
15" to 20" RAINFALL: AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Streambank Wheatgrass	Agropyron riparium	25
Bluebunch Wheatgrass	Agropyron spicatum	25
Idaho Fescue	Festuca idahoensis	25
Prairie Junegrass	Koeleria pyramidata	25
15" to 20" RAINFALL: NON-AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Streambank Wheatgrass	Agropyron riparium	20
Bluebunch Wheatgrass	Agropyron spicatum	20
Idaho Fescue	Festuca idahoensis	19
Prairie Junegrass	Koeleria pyramidata	20
Blue Wildrye	Elymus glaucus	20
Silky Lupine	Lupinus sericeus	1
15-20 INCHES RAINFALL: LOW GROWING, "SOD" TYPE MIXTURE		
Species	**Formal Name**	**% by Weight**
Thickspike Wheatgrass	Agropyron dasystachyum	20
Streambank Wheatgrass	Agropyron riparium	20
Western Wheatgrass	Agropyron smithii	20
Hard Fescue	Festuca ovina duriuscula	20
Canada Bluegrass	Poa compressa	19.5
Tailcup Lupine	Lupinus caudatus	0.5

20" RAINFALL OR MORE: AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Blue Wildrye	Elymus glaucus	30
Slender Wheatgrass	Agropyron trachycaulum	30
Mountain Brome	Bromus marginatus	25
Tufted Hairgrass	Deschampsia caespitosa	15
20" RAINFALL OR MORE: NON-AGRICULTURAL LAND		
Species	**Formal Name**	**% by Weight**
Blue Wildrye	Elymus glaucus	30
Slender Wheatgrass	Agropyron trachycaulum	30
Mountain Brome	Bromus marginatus	25
Tufted Hairgrass	Deschampsia caespitosa	10
Mountain Lupine	Lupinus alpestris	5
20" RAINFALL OR MORE: WETLANDS/RETENTION PONDS		
Species	**Formal Name**	**% by Weight**
American Sloughgrass	Beckmannia syzigachne	30
American Mannagrass	Glyceria grandis	30
Fowl Mannagrass	Glyceria striata	30
Hardstem Bulrush	Scripus acutus	2
Alkali Bulrush	Scripus maritimus	1.5
Cattail	Typha latifolia	1
Nebraska Sedge	Carex nebraskensis	0.5
Mountain Lupine	Lupinus alpestris	5

- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.2.

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3.3.2 Mulching

Definition

Application of organic material to protect bare soil from raindrop and sheet erosion, in addition to enhancing seed germination.

Purpose

Mulch provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There are numerous mulches that can be used, such as straw, wood chips (hog-fuel), wood fibers, and compost.

WSDOT Specification

2004 Standard Specifications
8-01.3(2)B Temporary Mulching
Temporary mulch, such as straw, wood cellulose (with and without tackifier), compost, or other best management practices as approved by the Engineer, may be applied at any time of the year for soil cover. Temporary mulching shall be in accordance with Section 8-02.3(15).

8-02.3(15)D Mulching
Mulch of the type specified in the Special Provisions shall be furnished, hauled, and evenly applied at the rates indicated and shall be spread on seeded areas within 48 hours after seeding unless otherwise specified. Distribution of straw mulch material shall be by means of an approved mulch spreader that utilizes forced air to blow mulch material on seeded areas. In spreading straw mulch, the spreader shall not cut or break the straw into short stalks. Wood cellulose fiber may be applied with seed and fertilizer West of the summit of the Cascade Range. East of the summit of the Cascade Range, seed and fertilizer shall be applied in one application followed by the application of wood cellulose fiber. Wood cellulose fiber used as mulch shall be suitable for application with a hydro seeder as specified in Section 8-02.3(15)B. Areas not accessible by mulching equipment shall be mulched by approved hand methods. Mulch sprayed on signs or sign structures shall be removed the same day.

Additional Information

- Compost is a popular material for mulching due to soil amending properties that benefit plant growth and because of its significant stormwater infiltration capacity. Compost must be sufficiently aged or digested and meet the materials specification in Section 9-14.4(8) to prevent leaching of nutrients into the runoff.
- Wood chips left over from land clearing activities are also a great mulch. During the decomposition process, however, a nitrogen deficiency in the soil can occur making it difficult for plants to grow well.
- Wood chip mulch is also a suitable material for stabilizing entrances and haul roads.
- Hand spread straw is less likely to be displaced because of its weight and length. Blown straw is smaller and may be more susceptible to wind and rain action.
- Tackifiers ranging from organic to inorganic are available for use to prevent displacement by wind and rain (Refer to 8-01.3(2)C Soil Binding Using Polyacrylamide (PAM), and 8-02.3(15) Erosion Control Seeding, Fertilizing, and Mulching).

- Consult with the Engineer to determine which mulch is best for the project.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.2.

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3.2.3 Blankets and Mats

Definition

A blanket made of natural plant material or synthetic fibers, which is rolled out and fastened to the soil surface to protect soil from raindrop and sheet erosion.

Purpose

Erosion control blankets protect soil from raindrop and sheet erosion until permanent vegetation is established. Organic blankets are made of either jute, straw, wood shavings, coconut fiber (coir) or varying combinations of each. Product longevity ranges from six months to five years depending on composition of blanket and environmental conditions. Synthetic blankets often contain materials that resist ultraviolet light and last more than five years. While most are suitable for slopes, others can be used in ditches with considerable volumes/velocities.

WSDOT Specification

2004 Standard Specifications
8-01.3(3) Placing Erosion Control Blanket
When required, erosion control blanket shall be placed immediately following the seeding and fertilizing operation. Temporary erosion control blankets as defined in 9-14.5, having an open area of 60% or greater, may be installed prior to seeding.

Refer to WSDOT Standard Plan I-12 & I-13 in Section 4

Additional Information

Refer to WSDOT Products Database for more information on blanket types, features, and manufacturers.

Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.2.

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3.2.4 Plastic Covering

Definition

The covering of bare areas with plastic sheeting to provide immediate erosion protection.

Purpose

The three main uses for plastic include providing: (1) immediate coverage of slopes and stockpiles; (2) short term coverage where mulch or blankets are not an option; and (3) protection from extreme cold weather to encourage early growth of vegetation.
WSDOT Specification

WSDOT Specification

2004 Standard Specifications
8-01.3(5) Placing Plastic Covering
Plastic meeting the requirements of Section 9-14.5(3) shall be placed with at least a 12-inch overlap of all seams. Clear plastic covering shall be used to promote growth of vegetation. Black plastic covering shall be used for stockpiles or other areas where vegetative growth is unwanted. The cover shall be maintained tightly in place by using sandbags on ropes in a 10-foot, maximum, grid. All seams shall weighted down full length.

Additional Information

- Plastic provides 100% protection of the soil, however, it collects 100% of the rain and transfers the erosion potential elsewhere. Therefore, energy dissipation below the plastic, as well as conveyance of runoff should be anticipated.
- As with erosion blankets, plastic must be keyed in at the top of the slope to prevent water from going under the plastic and upslope sheets must be placed over downslope sheets like shingles on a roof.
- There is a belief that plastic is cheap and easy to use. This is not always the case. Data shows that the average cost per square yard of installed plastic is $1.90. When maintenance, removal, and disposal costs are added, a more accurate figure is $2.20 to $2.50 per square yard.
- By way of comparison, erosion blankets average $1.20 to $1.75 per square yard installed.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.2.

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3.2.5 Polyacrylamide for Soil Erosion Protection

Definition

PAM is a long-chain polymer developed to clarify drinking water that can be used in erosion control because of its ability to stabilize soils and remove fine suspended sediments from stormwater runoff at highway construction sites. PAM also increases infiltration rates in soils by preventing surface sealing.

Purpose

Applying PAM to bare soil in advance of a rain event reduces erosion and controls sediment. First, PAM binds soil particles together and reduces the affects of raindrop and sheet erosion. As a result, stormwater infiltration is increased because the soil pore volume is not clogged with fine sediments. Second, stormwater pond performance is enhanced because sediment that reaches the pond will contain PAM. The polymer binds the smaller particles together making longer, heavier particles that settle out of suspension faster than in the absence of PAM.

WSDOT Specification

2004 Standard Specifications
8-01.3(2)C Soil Binding Using Polyacrylamide (PAM)
The PAM shall be completely dissolved and mixed in water prior to being applied to the soil. PAM shall be applied only on bare soil at a rate of not more than 0.5 pounds per 1M gallons of water per acre. A minimum of 200 pounds per acre of cellulose fiber mulch treated with a non-toxic dye shall be applied with the PAM. PAM shall be applied only to areas that drain to completed sedimentation control BMPs in accordance with the TESC plan. PAM shall not be applied to the same area more than once in a 48 hour period, or more than 7 times in a 30 day period. PAM shall not be applied during a rain or to saturated soils.

Additional Information

- PAM products shall meet ANSI/NSF Standard 60 for drinking water treatment. PAM shall be "anionic" (non-ionic) and linear (non-crosslinked). The minimum average molecular weight shall be 5 Mg/mole.
- PAM shall not be directly applied to water or allowed to enter a water body.
- In areas that drain to a sediment pond, PAM can be applied to bare soil under the following conditions:
  - During rough grading operations
  - Staging areas.
  - Balanced cut and fill earthwork.
  - Haul roads prior to placement of crushed rock surfacing.
  - Compacted soil roadbase.
  - Stockpiles.
  - After final grade and before paving or final seeding and planting.
  - Pit sites.

- For sites having a winter shut down, or where soil will remain un-worked for several months, PAM should be used in combination with mulch.
- For small areas that need coverage, PAM can be applied at the dry application rate of 5 lbs/acre using a hand-held "organ grinder" seed spreader.
- Depending on site conditions, PAM will last 3 to 6 months in the soil from the date of application. Extreme weather and heavy traffic (if used on haul roads) will shorten the lifespan and will require more frequent application.
- Refer to the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington, Volume II* for more information on PAM.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.2.

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WSDOT Standard Specification for Maintenance

2004 Standard Specifications
8-01.3(15) Maintenance
Erosion control devices shall be maintained so they properly perform their function until the Engineer determines they are no longer needed. The devices shall be inspected on the schedule outlined in Section 8-01.3(1)B for damage and sediment deposits. Damage to or undercutting of the device shall be repaired immediately.

3.3 Permanent Cover

3.2.1 Preserving Natural Vegetation

Definition

Minimizing exposed soils by clearing only where construction will occur.

Purpose

Vegetation provides the following benefits: (1) rainfall impact (energy) absorption; (2) reduction of runoff volumes and velocities; (3) sediment trapping; and (4) root stabilization of soil. Preserving natural vegetation reduces the need to spend money on BMPs which try to mimic these natural benefits.

WSDOT Specification

2004 Standard Specifications
1-07.16(2) Vegetation Protection and Restoration
Existing vegetation, where shown in the Plans or designated by the Engineer, shall be saved and protected through the life of the contract. The Engineer will designate the vegetation to be saved and protected by a site preservation line and/or individual flagging. Damage which may require replacement of vegetation includes bark stripping, broken branches, exposed root systems, cut root systems, poisoned root systems, compaction of surface soil and roots, puncture wounds, drastic reduction of surface roots or leaf canopy, changes in grade greater than 6 inches, or any other changes to the location that may jeopardize the survival or health of the vegetation to be preserved.

When large roots of trees designated to be saved are exposed by the Contractor's operation, they shall be wrapped with heavy burlap for protection and to prevent excessive drying. The burlap shall be kept moist and securely fastened until the roots are covered to finish grade. All burlap and fastening material shall be removed from the roots before covering. All roots 1 inch or smaller in diameter, which are damaged, shall be pruned with a sharp saw or pruning shear. Damaged, torn, or ripped bark shall be removed as directed by the Engineer. If due to, or for any reason related to the Contractor's operation, any tree, shrub, ground cover or herbaceous vegetation designated to be saved is destroyed, disfigured, or damaged to the extent that continued life is questionable as determined by the Engineer, it shall be removed by the Contractor at the direction of the Engineer.

The Contractor will be assessed damages equal to triple the value of the vegetation as determined in the *Guide for Plant Appraisal*, Eighth Edition, published by the International Society of Arboriculture or the estimated cost of restoration with a similar species. Shrub, ground cover, and herbaceous plant values will be determined using the Cost of Cure Method. Any damage so assessed will be deducted from the monies due or that may become due the Contractor.

Additional Information

Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

Notes _____

3.3.2 Buffer Zones

Definition

An undisturbed strip of natural vegetation or an established suitable planting between sensitive areas and land-disturbing activities that traps sediment and reduces runoff velocities and volumes.

Purpose

Buffer zones provide critical habitat adjacent to streams and wetlands, as well as assist in controlling erosion, especially on unstable steep slopes.

WSDOT Specification

2004 Standard Specifications
1-07.16(2) Vegetation Protection and Restoration
Existing vegetation, where shown in the Plans or designated by the Engineer, shall be saved and protected through the life of the contract. The Engineer will designate the vegetation to be saved and protected by a site preservation line and/or individual flagging. Damage which may require replacement of vegetation includes bark stripping, broken branches, exposed root systems, cut root systems, poisoned root systems, compaction of surface soil and roots, puncture wounds, drastic reduction of surface roots or leaf canopy, changes in grade greater than 6 inches, or any other changes to the location that may jeopardize the survival or health of the vegetation to be preserved.

When large roots of trees designated to be saved are exposed by the Contractor's operation, they shall be wrapped with heavy burlap for protection and to prevent excessive drying. The burlap shall be kept moist and securely fastened until the roots are covered to finish grade. All burlap and fastening material shall be removed from the roots before covering. All roots 1 inch or smaller in diameter, which are damaged, shall be pruned with a sharp saw or pruning shear. Damaged, torn, or ripped bark shall be removed as directed by the Engineer. If due to, or for any reason related to the Contractor's operation, any tree, shrub, ground cover or herbaceous vegetation designated to be saved is destroyed, disfigured, or damaged to the extent that continued life is questionable as determined by the Engineer, it shall be removed by the Contractor at the direction of the Engineer.

The Contractor will be assessed damages equal to triple the value of the vegetation as determined in the *Guide for Plant Appraisal*, Eighth Edition, published by the International Society of Arboriculture or the estimated cost of restoration with a similar species. Shrub, ground cover, and herbaceous plant values will be determined using the Cost of Cure Method. Any damage so assessed will be deducted from the monies due or that may become due the Contractor.

Additional Information

- Many local jurisdictions require that buffer zones be identified and protected with signs and fencing around wetlands, streams, and other sensitive areas.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

Notes _____

3.3.3 Permanent Seeding and Planting

Definition

The establishment of perennial vegetative cover on disturbed areas. Species are often native to the region.

Purpose

To prevent soil erosion by wind or water, and to improve wildlife habitat and site aesthetics.

WSDOT Specification

2004 Standard Specifications

8-02.3(15)A Preparation For Final Application

Areas to be cultivated are shown in the Plans or specified in the Special Provisions. The areas shall be cultivated to the depths specified to provide a reasonably firm but friable seedbed. Cultivation shall take place no sooner than two weeks prior to seeding. All areas to be seeded, including excavated slopes shall be compacted and prepared unless otherwise specified or ordered by the Engineer. Unless seed is covered with soil immediately after seed application, a cleated roller, crawler tractor, or similar equipment, approved by the Engineer that forms longitudinal depressions at least 2 inches deep shall be used for compaction and preparation of the surface to be seeded. The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope unless otherwise approved by the Engineer. The soil shall be conditioned with sufficient water so the longitudinal depressions remain in the soil surface until completion of the seeding. The area shall be compacted within three weeks prior to seeding. Prior to seeding, the finished grade of the soil shall be 1 inch, or the specified depth of mulch, below the top of all curbs, catch basins, junction and valve boxes, walks, driveways, and other structures.

8-02.3(15)B Seeding and Fertilizing

Seed and fertilizer shall be placed at the rate, mix and analysis specified in the Special Provisions or as designated by the Engineer. The Contractor shall notify the Engineer not less than 24 hours in advance of any seeding operation and shall not begin the work until areas prepared or designated for seeding have been approved. Following the Engineer's approval, seeding of the approved slopes shall begin immediately. Seeding shall not be done during windy weather or when the ground is frozen, excessively wet, or otherwise untillable. Seed and fertilizer may be sown by one of the following methods:

1. An approved hydro seeder that utilizes water as the carrying agent, and maintains continuous agitation through paddle blades. It shall have an operating capacity sufficient to agitate, suspend, and mix into a homogeneous slurry the specified amount of seed and water or other material. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic discharge spray nozzles that will provide a uniform distribution of the slurry.

2. Approved blower equipment with an adjustable disseminating device capable of maintaining a constant, measured rate of material discharge that will ensure an even distribution of seed at the rates specified.

3. Helicopters properly equipped for aerial seeding.

4. Approved power-drawn drills or seeders.

5. Areas in which the above methods are impractical may be seeded by approved hand methods. When seeding by hand, the seed shall be incorporated into the top 1/4 inch of soil by hand raking or other method that is approved by the Engineer. The seed shall have a tracer added to visibly aid uniform application. This tracer shall not be harmful to plant and animal life. If wood cellulose fiber is used as a tracer, the application rate shall not exceed 250 pounds per acre. Hand seeding operations are excluded from this requirement. Seed and fertilizer may be applied in one application provided that the fertilizer is placed in the hydro seeder tank no more than one hour prior to application.

8-02.3(15)C Liming
Agricultural lime shall be applied at the rates specified in the Special Provisions. The method of application shall be in conformance with all air and water pollution regulations and shall be approved by the Engineer.

8-02.3(15)D Mulching
Mulch of the type specified in the Special Provisions shall be furnished, hauled, and evenly applied at the rates indicated and shall be spread on seeded areas within 48 hours after seeding unless otherwise specified. Distribution of straw mulch material shall be by means of an approved mulch spreader that utilizes forced air to blow mulch material on seeded areas. In spreading straw mulch, the spreader shall not cut or break the straw into short stalks. Wood cellulose fiber may be applied with seed and fertilizer West of the summit of the Cascade Range. East of the summit of the Cascade Range, seed and fertilizer shall be applied in one application followed by the application of wood cellulose fiber. Wood cellulose fiber used as mulch shall be suitable for application with a hydro seeder as specified in Section 8-02.3(15)B. Areas not accessible by mulching equipment shall be mulched by approved hand methods. Mulch sprayed on signs or sign structures shall be removed the same day.

8-02.3(15)E Soil Binder or Tacking Agent
When the proposal includes a pay item for soil binders and tacking agents, they shall be applied in accordance with the manufacturer's recommended requirements. Tackifiers used as a tie-down for seed and mulch shall be applied in quantities sufficient to equal the retention properties of guar when applied at the rate of 60 pounds per acre.

8-02.3(15)F Dates for Application of Final Seed, Fertilizer, and Mulch
Unless otherwise approved by the Engineer, the final application of seeding, fertilizing, and mulching of slopes shall be performed during the following periods:

West of the summit of the Cascade Range - March 1 to May 15 and August 15 to October 1. Where contract timing is appropriate, seeding, fertilizing, and mulching shall be accomplished during the fall period listed above. Written permission to seed after October 1 will only be given when physical completion of the project is imminent and the environmental conditions are conducive to satisfactory growth.

East of the summit of the Cascade Range - October 1 to November 15. Seeding, fertilizing, and mulching shall be accomplished during this fall period only.

8-02.3(15)G Protection and Care of Seeded Areas
In addition to the requirements of Section 1-07.13(1), the contractor shall be responsible for performing the following duties:

1. Protect all areas involved against vehicle and pedestrian traffic by use of approved warning signs and barricades.

2. Areas, which have been damaged through any cause prior to final inspection, and areas failing to receive a uniform application at the specified rate, shall be reseeded, refertilized, and remulched at the Contractor's expense.

3. Seeded areas within the planting area shall be considered part of the planting area. Weeds within the seeded areas shall be controlled in accordance with Section 8-02.3(3).

Additional Information

- Refer to section 3.1.1, Temporary Seeding, for various seed mixes.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

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3.3.4 Sodding

Definition

Stabilizing fine-graded disturbed areas by establishing permanent grass stands with sod.

Purpose

To establish permanent turf for immediate erosion protection or to stabilize drainage ways where concentrated overland flow will occur.

WSDOT Specification

2004 Standard Specifications
9-14.6(8) Sod
The available grass mixtures on the current market shall be submitted to the Engineer for selection and approval. The sod shall be field grown one calendar year or older, have a well developed root structure, and be free of all weeds, disease, and insect damage. Prior to cutting, the sod shall be green, in an active and vigorous state of growth, and mowed to a height not exceeding 1 inch. The sod shall be cut with a minimum of 1 inch of soil adhering.

Additional Information

- Sod may be more expensive than other permanent cover BMP's but because the grass is already established, instant protection is provided.
- In swales, placing sod strips perpendicular to the flow of water increases its ability to resist shear stress.
- Staggering sod strips will produce a tight fit.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

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3.3.5 Topsoiling

Definition

Preserving or importing topsoil to promote vegetation establishment in nutrient-poor soils.

Purpose

To provide a suitable growth medium for final site stabilization.

WSDOT Specification

2004 Standard Specifications Page 8-13
8-02.3(4) Topsoil
Topsoil shall be evenly spread over the specified areas to the depth shown in the Plans or as otherwise ordered by the Engineer. The soil shall be cultivated to a depth of 1 foot or as specified in the Special Provisions or the Plans. After the topsoil has been spread, all large clods, hard lumps, and rocks 3 inches in diameter and larger, and litter shall be raked up, removed, and disposed of by the Contractor. Topsoil shall not be placed when the ground or topsoil is frozen, excessively wet, or in the opinion of the Engineer in a condition detrimental to the work.

8-02.3(4)A Topsoil Type A
Topsoil Type A shall be as specified in the Special Provisions.

8-02.3(4)B Topsoil Type B
Topsoil Type B shall be native topsoil taken from within the project limits and shall meet the requirements of Section 9-14.1(2). Topsoil Type B shall be taken from areas designated by the Engineer to the designated depth and stockpiled at locations that will not interfere with the construction of the project, as approved by the Engineer. Areas beyond the slope stakes shall be disturbed as little as possible in the above operations. When topsoil Type B is specified, it shall be the Contractor's responsibility to perform the excavation operations in such a manner that sufficient material is set aside to satisfy the needs of the project. Upon physical completion of the work, topsoil Type B remaining and not required for use on the project shall be disposed of by the Contractor at no expense to the Contracting Agency and to the satisfaction of the Engineer. Should a shortage of topsoil Type B occur, and the Contractor has wasted or otherwise disposed of topsoil material, the Contractor shall furnish topsoil Type C at no expense to the Contracting Agency. Topsoil Type B will not be considered as selected material, as defined in Section 2- 03.3(10), and the conditions of said section shall not apply. Materials taken from roadway excavation, borrow, stripping, or other excavation items, and utilized for topsoil, will not be deducted from the pay quantities for the respective items.

8-02.3(4)C Topsoil Type C
Topsoil Type C shall be native topsoil obtained from a source provided by the Contractor outside of the Contracting Agency-owned right of way. Topsoil Type C shall meet the requirements of Section 8-02.3(4)B and Section 9-14.1(2).

Additional Information

Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

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3.3.6 Conveyance Channel Stabilization

Definition

Conveyance channels move water and are categorized as flexible and rigid. Flexible include vegetation, blankets, gravel, and small-medium sized riprap. Rigid include pvc/concrete pipe, asphalt, and large rock.

Purpose

Conveyance channels are used to convey water from a project to a stable location capable of handling a given volume of water without causing erosion.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

The following general guidance comes from the Hydraulic Engineering Circular No. 15 – Design of Roadside Channels with Flexible Linings, Federal Highways Department publication (No. FHWA-IP-87-7).

The following principles must be considered when designing stable channels:

- Size channels to convey expected flows. Instructions on how to calculate peak runoff rates are provided in *Highway Runoff Manual*.
- Bare soil has very little resistance to erosion when subjected to concentrated flows. Channels must be armored to withstand expected erosive forces.
- Limit flow velocities if necessary to prevent damage to channel liners.
- Flexible liners are not as strong as rigid liners but are able to conform to changes in channel shape while maintaining the overall lining integrity. As a general guideline only rigid liners should be used in channels with shear stresses exceeding 8 lb/ft^2 or on slopes exceeding 10% (unless using properly sized riprap). Table 3.2.6A summarizes the advantages and disadvantages of the two liner types.

Table 3.2.6A Flexible Versus Rigid Lined Conveyances

Flexible	Rigid
Advantages • Inexpensive to install and maintain (grass lined ditches are self-healing) • Provide water quality treatment • Allow some infiltration • Cause less increase in peak flows	**Advantages** • Maximizes conveyance capacity using limited space • Fully effective immediately (no need to wait for grass to grow) • Can be designed to withstand and level of shear stress.
Disadvantages • Excessive flows can cause erosion • Vegetation requires time to become established • Requires more space • Not be used in channels where shear stress exceeds 8 lb/ft 2 or slopes exceeding 10% (except riprap)	**Disadvantages** • Expensive to build, maintain and repair • Increased peak discharge rates more likely to cause downstream erosion • No infiltration • No water quality treatment

The potential for erosion is based on shear stress, which is the force required to pull or peel (erode) material off of the bottom or sides of a ditch. Shear stress can be calculated using the following formula.

Shear Stress = WHG where:

W = Weight of water (62.4 lb/ft^3)
H = Height of water in feet
G = Channel gradient in ft/ft
(Channel gradient and water height in this formula assume an unobstructed flow of water in the ditch.)

Sample Shear Stress Calculation:

What is the shear stress in a straight ditch with a slope of 5% when the water is 1 foot deep?

Shear stress = (62.4 lb/ft^3)(1 ft)(.05) = 3.1 lb/ft^2

Using shear stress to determine effective liner types:

Table 3.2.6B indicates the maximum shear stresses that several different types of flexible liner materials can withstand. As a general guideline, multiply the expected maximum shear stress by 3 (a 30% safety factor is built in) to the diameter or riprap needed to stabilize a ditch. Manufacturers provide the shear strength ratings for erosion control blankets. Selection of liner material should be based upon the maximum shear stress that products or specified rock sizes can withstand.

Sample Calculation and Product Selection Process:

What flexible liner materials are adequate to stabilize a ditch with a 3% slope and an expected flow depth of 1.5 feet.

Shear stress = (62.4 lb/ft^3)(1.5 ft)(.03) = 2.81 lb/ft^2

If rock were used a minimum mean stone size of at least 8.4 inches should be used because (2.81) (3.0 conversion factor) = 8.4

Numerous coir erosion control blankets and synthetic turf reinforcement products could be substituted for rock with potentially significant cost savings. A well-established healthy stand of grass could also withstand the expected shear stresses in the ditch and help purify the runoff.

Table 3.2.6B Maximum Permissible Shear Stresses for Flexible Liners

Liner Category	Liner Type	Permissible Shear Stress (lbs/ft^2)
Bare soil - No liner	Non-cohesive soil Cohesive soil	0.01-0.04 up to 0.1 (non-compacted) up to 0.8 (compacted)
Erosion control blankets (Temporary / Permanent)*	Jute Curlex wood or straw Coir Organic, synthetic, or mix	0.45-1.0 1.0-2.5 2.0-4.0 10.0-12.0
Vegetative**	Uncut stand Cut grass	2.1-3.7 0.6-1.0
Gravel/riprap	1-inch 2-inch 6-inch 12-inch	0.33 0.67 2.0 4.0

* Permissible shear stresses based on products chosen at random to give a general idea of blanket strengths by material type. This table does not reflect the full range of permissible shear stresses for each product type.
** Varies with type and density of grass stand.

- Check dams can greatly reduce the velocity of flowing water, thereby reducing shear stress. Check dams can prevent erosion until the permanent grass liner is established. Temporary slope drains provide rigid lined conveyances until the permanent rigid or flexible lined channels are completed.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.3.

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WSDOT Standard Specification for Maintenance

2004 Standard Specifications
8-01.3(15) Maintenance
Erosion control devices shall be maintained so they properly perform their function until the Engineer determines they are no longer needed. The devices shall be inspected on the schedule outlined in Section 8-01.3(1)B for damage and sediment deposits. Damage to or undercutting of the device shall be repaired immediately.

3.4 Structural Erosion Control

3.4.1 Fencing

Definition

Installing a physical barrier to define a project boundary or protect a sensitive feature.

Purpose

Fencing restricts clearing to approved limits, prevents disturbance of sensitive areas, and limits construction traffic to designated roads and entrances.

WSDOT Specification

No WSDOT Standard Specification exists for other fencing materials; therefore, a special provision must be written.

Additional Information

- Fencing is used to meet minimum requirements 2 and 3 of a TESC plan.
- Suitable fencing materials include plastic safety fence, metal fence, and silt fence. Silt fence is appropriate in areas where there is a concern of turbid runoff leaving the site. However, safety fence and other material should always be considered in place of silt fence where there is no concern of runoff.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.2 Stabilized Construction Entrance

Definition

A temporary stone-stabilized pad located at points of vehicular ingress and egress on a construction site.

Purpose

To reduce the amount of mud, dirt, rocks, etc., transported onto public roads by motor vehicles or runoff by constructing a stabilized pad of rock spalls at entrances to construction sites.

WSDOT Specification

2004 Standard Specifications
8-01.3(7) Stabilized Construction Entrance
Temporary stabilized construction entrance shall be constructed in accordance with the Plans, prior to beginning any clearing, grubbing, earthwork or excavation. When the stabilized entrance no longer prevents track out of sediment or debris, the Contractor shall either rehabilitate the existing entrance to original condition, or construct a new entrance. When the contract requires a tire wash in conjunction with the stabilized entrance, the Contractor shall include details for the tire wash and the method for containing and treating the sediment-laden runoff as part of the erosion control plan. All vehicles leaving the site shall stop and wash sediment from their tires.

Refer to WSDOT Standard Plan I-14 in Section 4.

Additional Information

- The same practice can be implemented for all staging and employee parking areas for the project.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.3 Tire Wash

Definition

A system using a sump and spray equipment to remove sediment from vehicles during egress.

Purpose

A tire wash is used when a stabilized construction entrance does not prevent sediment from being tracked onto pavement.

WSDOT Specification

2004 Standard Specifications
8-01.3(7) Stabilized Construction Entrance
Temporary stabilized construction entrance shall be constructed in accordance with the Plans, prior to beginning any clearing, grubbing, earthwork or excavation. When the stabilized entrance no longer prevents track out of sediment or debris, the Contractor shall either rehabilitate the existing entrance to original condition, or construct a new entrance. When the contract requires a tire wash in conjunction with the stabilized entrance, the Contractor shall include details for the tire wash and the method for containing and treating the sediment-laden runoff as part of the erosion control plan. All vehicles leaving the site shall stop and wash sediment from their tires.

Additional Information

- Effective function requires participation by and communication with vehicle drivers.
- Wash water should be disposed of in a way that does not violate water quality standards.
- Local jurisdictions may require a tire wash as a permit condition.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.3 Construction Road Stabilization

Definition

The temporary stabilization of access roads and other on-site vehicle transportation routes immediately after grading.

Purpose

To reduce dust generation during dry weather and erosion of temporary roadbeds by construction traffic during wet weather and to eliminate the need for regrading of permanent roadbeds between the time of initial grading and final stabilization.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used, but this is likely to require more maintenance. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- A 6-inch depth of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course can be applied immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. It may also be possible to use cement or calcium chloride for soil stabilization. If cement or cement kiln dust is used for roadbase stabilization, pH monitoring and BMPs are necessary to evaluate and minimize the effects on stormwater.
- Roadways shall be carefully graded to drain. Drainage ditches shall be provided on each side of the roadway in the case of a crowned section, or on one side in the case of a super-elevated section. Drainage ditches should be directed to a sediment control BMP.
- Rather than relying on ditches, it may also be possible to grade the road so that runoff sheet-flows into a heavily vegetated area with a well-developed topsoil. Landscaped areas are not adequate. If this area has at least 50 feet of vegetation, then it is generally preferable to use the vegetation to treat runoff, rather than a sediment pond or trap.
- Project storm drain inlets shall be protected to prevent sediment-laden water entering the storm drain system.
- Inspect stabilized areas regularly, especially after large storm events.
- Crushed rock, gravel base, hog fuel, etc. shall be added as required to maintain a stable driving surface and to stabilize any areas that have eroded.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.5 Dust Control

Definition

Reducing surface and air movement of dust during land disturbing, demolition, and construction activities.

Purpose

To prevent surface and air movement of dust where on-site and off-site impacts to roadways, drainage ways, or surface waters are likely.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.
Additional Information

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place.
- Construct natural or artificial windbreaks or windscreens.
- Spray the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance.
- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Used oil is prohibited from use as a dust suppressant. Local governments may approve other dust palliatives such as calcium chloride or PAM.

Techniques that can be used for unpaved roads and lots include:

- Lower speed limits.
- Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those passing a #200 screen) to 10 to 20 percent.
- Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- Encourage the use of alternate, paved routes, if available.
- Restrict use by tracked vehicles and heavy trucks to prevent damage to road surface and base.

- Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
- Pave unpaved permanent roads and other high-traffic areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.

Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.6 Surface Roughening

Definition

Creating longitudinal depressions perpendicular to the natural flow of runoff by using a cleated roller, crawler tractor, or similar equipment.

Purpose

To aid in the establishment of vegetative cover by reducing runoff velocity, increasing infiltration, and providing for sediment trapping.

WSDOT Specification

2004 Standard Specifications
8-02.3(15)A Preparation For Final Application
Areas to be cultivated are shown in the Plans or specified in the Special Provisions. The areas shall be cultivated to the depths specified to provide a reasonably firm but friable seedbed. Cultivation shall take place no sooner than two weeks prior to seeding. All areas to be seeded, including excavated slopes shall be compacted and prepared unless otherwise specified or ordered by the Engineer. Unless seed is covered with soil immediately after seed application, a cleated roller, crawler tractor, or similar equipment, approved by the Engineer that forms longitudinal depressions at least 2 inches deep shall be used for compaction and preparation of the surface to be seeded. The entire area shall be uniformly covered with longitudinal depressions formed perpendicular to the natural flow of water on the slope unless otherwise approved by the Engineer. The soil shall be conditioned with sufficient water so the longitudinal depressions remain in the soil surface until completion of the seeding. The area shall be compacted within three weeks prior to seeding. Prior to seeding, the finished grade of the soil shall be 1 inch, or the specified depth of mulch, below the top of all curbs, catch basins, junction and valve boxes, walks, driveways, and other structures.

Additional Information

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3:1) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.
- Graded areas with slopes greater than 3:1 but less than 2:1 should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.7 Gradient Terraces

Definition

A terrace cut horizontally into a slope, designed according to criteria that considers slope length and height.

Purpose

Address erosion damage by reducing slope length and gradient, thereby reducing runoff velocity and allowing water to infiltrate.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance.
- Terraces should direct water to suitable outlets and should be inspected regularly.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.8 Water Bars

Definition

A small ditch cut perpendicular to the flow of water in roads or hillsides. A cross-sectional view reveals a ditch with the excavated material placed on the downslope side.

Purpose

To reduce slope length, intercept surface runoff, and direct it to a proper drainage.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Water bar outlet should be stabilized with rock or vegetation.
- The following table provides general guidance in spacing water bars based on slope.

Slope (%)	Spacing (ft)
<5	125
5-10	100
10-20	75
20-35	50

- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

3.4.9 Temporary Pipe Slope Drains

Definition

A pipe extending from the top to the bottom of a cut or fill slope and discharging into a stabilized conveyance, sediment trapping device, or stabilized outfall.

Purpose

To carry concentrated runoff down slopes without causing rills and gullies and to minimize saturation of slide-prone soils.

WSDOT Specification

2004 Standard Specifications
8- 01.3(14) Temporary Pipe Slope Drain
Pipe slope drain shall be constructed in accordance with the Plans and shall meet the requirements of Section 9-05.1(6). Water Interceptor dikes or temporary curbs shall be used to direct water into pipe slope drain. Entrance to drain may consist of prefabricated funnel device specifically designed for application, rock, sand bags, or as approved. The soil around and under the pipe section(s) shall be thoroughly compacted to prevent undercutting. Pipe shall be securely fastened together and have gasketed watertight fittings, and secured to the slope with metal "T" posts, wood stakes, sand bags, or as approved. Discharge the water to a stabilized conveyance, sediment trap, stormwater pond, rock splash pad, vegetated strip, or as approved. Placement of drain shall not pond water on road surface and create a road hazard to vehicles or pedestrians.

Additional Information

- The *Highway Runoff Manual* provides information for the calculation of flow rates and selection of pipe diameters large enough to convey the flow
- Pipe slope drains can be used when a temporary or permanent stormwater conveyance is needed to move the water down a slope to prevent erosion.
- On highway projects, they can be used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. These can be designed into a project and included as bid items. Another use on road projects is to collect runoff from pavement and pipe it away from side slopes. These are useful because there is generally a time lag between having the first lift of asphalt installed and the curbs, gutters, and permanent drainage installed.
- Water can be collected and channeled to inlets with sand bags, triangular silt dikes, berms, or other material, and piped to temporary sediment ponds, vegetated strips, and infiltration areas.
- Use temporary drains on new cut or fill slopes.
- Compact the soil around and under the pipe and entrance section to prevent undercutting.
- Securely connect the flared inlet section to the slope drain.
- Securely fasten multiple slope drain sections together or use gasketed watertight fittings.

- If 90 degree bends cannot be avoided, install thrust blocks constructed from sandbags, straw bales staked in place, "t" posts and wire, or ecology blocks.
- Secure pipe along its full length to prevent movement. This can be done with steel "t" posts and wire. A post is installed on each side of the pipe and the pipe is wired to them. This should be done every 10-20 feet of pipe length or so, depending on the size of the pipe and quantity of water to diverted.
- Pipe slope drains can be used to convey water collected by interceptor dikes. Ensure that the height of the dike be at least 1 foot higher at all points than the top of the inlet pipe.
- The area below the outlet must be stabilized with a riprap apron.
- If the pipe slope drain is conveying sediment-laden water, direct all flows into the sediment trapping facility.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.10 Temporary Curb

Definition

Curb installed at top of slope to convey water to stabilized conveyances, thereby preventing erosion on cut and fill slopes.

Purpose

To direct concentrated runoff to stabilized conveyances such as pipe slope drains in order to avoid rills and gullies and to minimize saturation of slide-prone soils.

WSDOT Specification

2004 Standard Specifications
8-01.3(13) Temporary Curb
Temporary curbs may consist of asphalt, concrete, sand bags, compost socks, wattles, or geotextile/plastic encased berms of soil, , sand or gravel, or as approved by the Engineer.
Temporary curbs shall be installed along pavement edges to prevent runoff from flowing onto erodible slopes. The redirected water shall flow to a BMP designed to convey concentrated runoff. The temporary curbs shall be 4 inches in height.

Additional Information

- Do not leave gaps in temporary curb without stabilized conveyance. Gaps left in curb will cause more severe gully erosion than if the curb wasn't there in the first place.

- When connecting pipe to curb, arrange curb material, such as sandbags or asphalt to form sump to minimize bypass of the pipe.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.11 Concrete Handling

Definition

To minimize and eliminate concrete process water from entering waters of the state.

Purpose

Reduce the impact to regulated water bodies resulting from concrete work including sawing, grinding, and resurfacing. Turbidity and pH are parameters impacted by concrete work.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Stormwater inlet protection measures should be placed around all catch basins in vicinity of concrete work.
- Performing concrete work in advance of storm events reduces the risk of generating concrete runoff and violating water quality standards.
- BMP's designed for spill prevention and containment can be used to eliminate the risk of discharging concrete runoff to receiving waters.
- Designated areas to hold process water and for tool washing stations will reduce the risk of losing concrete runoff. Dewatering in such areas needs to be done in a way that does not violate water quality standards.

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3.4.12 Level Spreader

Definition

A slightly elevated structure made of wood, sandbags, pipe, compost, gravel, or compacted earth that spans an area and converts concentrated runoff into sheet flow.

Purpose

By converting concentrated runoff to sheet flow, shear stress is reduced resulting in less erosion.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Used when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation.
- Use only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.
- Use above areas that are stabilized by vegetation.

If the level spreader has any low points, flow will concentrate, create channels and may cause erosion.

- The runoff shall not reconcentrate after release unless intercepted by another downstream measure.
- Level spreaders consisting of gravel or organic material should have a minimal amount of fine particles that could negatively influence turbidity.
- The spreader should span the full width of the channel. Use multiple spreaders for higher flows.
- The depth of the spreader as measured from the lip should be uniform across the entire width.
- Level spreaders shall be setback from the property line unless there is an easement for flow.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.13 Interceptor Dike and Swale

Definition

A ridge of compacted soil and a swale placed on a slope. These structures may or may not be vegetated.

Purpose

To intercept runoff and/or groundwater from drainage areas on slopes and direct it to a stabilized outlet.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

Use the dike and swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent runoff from entering the work area or sediment-laden runoff from leaving the construction site.

- When placed horizontally across a disturbed slope, it reduces the amount and velocity of runoff flowing down the slope.
- Stabilization of dike and swale with temporary or permanent vegetation is dependent upon soil characteristics and gradient. Low gradient highly porous soils may not require a higher level of protection.
- Steeper grades require swale protection, check dams, or level spreaders.
- Provide energy dissipation measures at swale outlet.
- Sediment-laden runoff must be released to a sediment trapping facility.
- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossing.

The following design criteria can be found in the WSDOT *Highway Runoff Manual*.

Design Criteria

Top Width	2 feet (600 mm) minimum.
Height	18 inches (450 mm) minimum. Measured from upslope toe and at a compaction of 90 percent ASTM D698 standard proctor.
Side Slopes	3:1 or flatter.
Grade	Topography dependent, except that dike shall be limited to grades between 0 5 and 1 0 percent

grades between 0.5 and 1.0 percent.

Horizontal Spacing of Interceptor Dikes

Slopes	<5%	=	300 feet (90 m)
Slopes	5-10%	=	200 feet (60 m)
Slopes	10-40%	=	100 feet (30 m)

Stabilization

Slopes = <5%	Seed and mulch applied within 5 days of dike construction (see BMP E1.10).
Slopes = 5-40%	Dependent on runoff velocities and dike materials. Stabilization should be done immediately using either sod or riprap to avoid erosion.

Outlet The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.

Other Minimize construction traffic over temporary dikes.

Bottom Width 2 feet (600 mm) minimum; the bottom shall be level.

Depth 1 foot (300 mm) minimum.

Side Slope 3:1 or flatter.

Grade Maximum 5 percent, with positive drainage to a suitable outlet (such as a sediment trap).

Interceptor dikes shall meet the following criteria:

Stabilization Seed as per BMP E1.10

Temporary Seeding, or Riprap 12 inches (300 mm) thick pressed into the bank and extending at least 8 inches (200 mm) vertical from the bottom.

Swale Spacing

Slope of Disturbed Area:	<5%	=	300 feet (90 m)
	5-10%	=	200 feet (60 m)
	10-40%	=	100 feet (30 m)

Outlet Level Spreader or Riprap to stabilized outlet/sedimentation pond.

- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.14 Stormwater Infiltration

Definition

The process of disposing water by allowing it to seep into duff or disperse into vegetation on or near the construction site.

Purpose

To treat turbid stormwater that would otherwise not meet water quality standards. This method can often be employed to create a zero discharge site, thereby eliminating the possibility of impacting surface waters.
WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Infiltration ponds work best on highly porous soils.
- Infiltration rates are usually higher in undisturbed, vegetated areas.
- Infiltration rates are limited on most sites, so creative means are often required to meet infiltration needs.
- Infiltration can be maximized by spreading water over the largest possible area, discharging water at a slow and constant rate, and using vegetated areas whenever possible.
- If an area becomes saturated, give it a break and try it again later.
- Empty ponds between storm events.
- Monitor infiltration areas and nearby surface waters. Infiltrating water on slopes may destabilize the slope causing structural failure.
- Always consult with and get approval from the WSDOT Project Engineer before dispersing or infiltrating water.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.15 Check Dams

Definition

Small dams constructed across a swale or drainage ditch. Suitable materials include riprap, washed gravel, sandbags, and prefabricated structures.

Purpose

To reduce the velocity of concentrated flows, reduce erosion of the swale or ditch, and cause some suspended sediment to settle in ponded areas upstream of check dams.

WSDOT Specification

2004 Standard Specifications
8-01.3(6) Check Dams
Check dams shall be installed as soon as construction will allow, or when designated by the Engineer. The Contractor may substitute a different check dam for that specified with approval of the Engineer. Check dams shall be placed in ditches perpendicular to the channel. Check dams shall be of sufficient height to maximize detention, without causing water to leave the ditch.

8-01.3(6)A Geotextile-Encased Check Dam
The geotextile-encased check dam shall meet the requirements in Section 9-14.5(4) Geotextile-Encased Check Dam. Installation of geotextile-encased check dams shall be in accordance with the Plans, and shall be anchored to hold it firmly in place under all conditions.

8-01.3(6)B Rock Check Dam
The rock used to construct rock check dams shall meet the requirements for quarry spalls, in accordance with Section 9-13.6.

8-01.3(6)C Sandbag Check Dam
Sandbags shall be placed so that the initial row makes tight contact with the ditch line for the length of the dam. Subsequent rows shall be staggered so the center of the bag is placed over the space between bags on the previous lift.

8-01.3(6)D Wattle Check Dam
Wattle used to construct wattle check dams shall meet the requirements for 8-01.3(10).

Refer to WSDOT Standard Plan I-11 in Section 4

Additional Information

- Whatever material is used, the dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the dam rather than falling directly onto the ditch bottom.
- The material used to fill sand bags should not contribute to turbid runoff. For example, use washed rock or pea gravel.
- Keep the center of the check dam lower than the outer edges at natural ground elevation to prevent flooding of roads, dikes, or other structures.

- Placing rock, geotextile, or erosion control blankets will reduce/eliminate scouring.
- Know the expected flow rates to determine the appropriate check dam material.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.16 Triangular Silt Dike (Geotextile-Encased Check Dam)

Definition

A pre-fabricated check dam consisting of a urethane foam core encased in geotextile material.

Purpose

To reduce the velocity of concentrated flows, reduce erosion of the swale or ditch, and cause some suspended sediment to settle in ponded areas upstream of check dams. A triangular silt dike can be mobilized and placed quickly. If they are taken care of, triangular silt dikes can be reused.

WSDOT Specification

2004 Standard Specifications
8-01.3(6) Check Dams
Check dams shall be installed as soon as construction will allow, or when designated by the Engineer. The Contractor may substitute a different check dam for that specified with approval of the Engineer. Check dams shall be placed in ditches perpendicular to the channel. Check dams shall be of sufficient height to maximize detention, without causing water to leave the ditch.

8-01.3(6)A Geotextile-Encased Check Dam
The geotextile-encased check dam shall meet the requirements in Section 9-14.5(4) Geotextile-Encased Check Dam. Installation of geotextile-encased check dams shall be in accordance with the Plans, and shall be anchored to hold it firmly in place under all conditions.

Refer to WSDOT Standard Plan I-10 in Section 4

Additional Information

The flexibility of the materials in triangular silt dikes allow them to conform to all channel configurations.

- Can be fastened to soil with staples or rock and pavement with adhesives.
- TSDs have been used to build temporary sediment ponds, diversion ditches, concrete wash out facilities, curbing, water bars, level spreaders, and berms.

- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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3.4.17 Outlet Protection

Definition

A protective barrier of rock, erosion control blankets, vegetation, or sod constructed at a conveyance outlet.

Purpose

To prevent scour at conveyance outlets and minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Common locations for outlet protection include ponds, pipes, ditches, or other conveyances.
- Size the scale of the outlet protection based on expected flow volumes and velocities.
- Refer to section 3.2.6 of this manual and/or the WSDOT *Highway Runoff Manual* for guidance in choosing appropriate sized rock outlet protection or alternative materials.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.4.

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WSDOT Standard Specification for Maintenance

8-01.3(15) Maintenance

Erosion control devices shall be maintained so they properly perform their function until the Engineer determines they are no longer needed. The devices shall be inspected on the schedule outlined in Section 8-01.3(1)B for damage and sediment deposits. Damage to or undercutting of the device shall be repaired immediately.

3.5 Sediment Retention

3.5.1 Vegetated Strip

Definition

A strip of dense vegetation adjacent to a land disturbing activity.

Purpose

To reduce the transport of sediment from a construction site by providing a physical barrier that reduces runoff velocities.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

Vegetated strips may be used downslope of all disturbed areas.

- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the following criteria are met (see Table 3.4.1):

Table 3.4.1 Vegetated Strips

Average Slope	Slope Percent	Flowpath Length
1.5H:1V or less	67% or less	100 feet
2H:1V or less	50% or less	115 feet
4H:1V or less	25% or less	150 feet
6H:1V or less	16.7% or less	200 feet
10H:1V or less	10% or less	250 feet

- Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.2 Wattles

Definition

Temporary erosion and sediment control barriers consisting of any plant material that is wrapped in biodegradable tubular plastic or similar encasing material. Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.

Purpose

There are two main purposes for wattles: 1) reduce slope length; and 2) trap sediment. Cutting a slope length in half reduces erosion potential by a factor of four. In addition, they also trap sediment whether used on a slope or as a perimeter control device.

WSDOT Specification

2004 Standard Specifications
8-01.3(10) Wattles
Wattles shall be installed as soon as construction will allow or when designated by the Engineer Trench construction and wattle installation shall begin from the base of the slope and work uphill. Excavated material shall be spread evenly along the uphill slope and compacted using hand tamping or other method approved by the Engineer. On gradually sloped or clay-type soils trenches shall be 2 to 3 inches deep. On loose soils, in high rainfall areas, or on steep slopes, trenches shall be 3 to 5 inches deep, or half the thickness of the wattle.

Refer to WSDOT Standard Plan I-8 in Section 4

Additional Information

- Wattles can also be used as temporary curbs for conveying water to catch basins and pipe slope drain inlets.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.3 Silt Fence

Definition

A temporary sediment barrier consisting of a geotextile fabric stretched across and attached to supporting posts, which are entrenched. Adding rigid wire fence backing can strengthen silt fence.

Purpose

To reduce the transport of sediment from a construction site by providing a temporary barrier to sediment and reducing the runoff velocities of sheet flow.

WSDOT Specification

2004 Standard Specifications
8-01.3(9)A Silt Fence
Silt fence shall be constructed in accordance with the Plans. When backup support is used, steel wire shall have a maximum mesh spacing of 2 inches by 4 inches, and the plastic mesh shall be as resistant to ultraviolet radiation as the geotextile it supports. The geotextile shall be attached to the posts and support system using staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be sewn together at the point of manufacture, or at a location approved by the Engineer, to form geotextile lengths as required. All sewn seams and overlaps shall be located at a support post. Posts shall be either wood or steel. Wood posts shall have minimum dimensions of 1 1/4 inches by 1 1/4 inches by the minimum length shown in the Plans. Steel posts shall consist of U, T, L, or C shape posts with a minimum weight of 1.33 lbs/ft, or other steel posts having equivalent strength and bending resistance to the posts listed. When sediment deposits reach approximately one-third the height of the silt fence, the deposits shall be removed.

Refer to WSDOT Standard Plan I-4 in Section 4

Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.4 Straw Bale Barrier

Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales.

Purpose

To intercept sheet flow and detain small amounts of sediment from disturbed areas.

WSDOT Specification

2004 Standard Specifications
8-01.3(9)C Straw Bale Barrier
Straw shall conform to Section 9-14.4(1).

Refer to WSDOT Standard Plan I-9 in Section 4

Additional Information

- Place below disturbed areas subject to sheet and rill erosion.
- They are more suitable for low gradient slopes and small drainage areas.
- The longevity of the barrier is dependent on the time of year and climate.
- Under no circumstances should straw bale barriers be constructed in streams, channels, or ditches.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.5 Filter Berm

Definition

A berm consisting of gravel, wood chips, or compost.

Purpose

There are two main functions of filter berms. The first is to prevent concentrated flows from damaging exposed cut/fill slopes. The second is to provide perimeter containment of sediment at the toe of a slope.

WSDOT Specification

2004 Standard Specifications
8-01.3(9)B Gravel Filter, Wood Chip or Compost Berm
The gravel filter berm shall be a minimum of one foot in height and shall be maintained at this height for the entire time they are in use. The wood chip berm shall be a minimum of two feet in height and shall be maintained at this height for the entire time they are in use. Wood chips shall meet the requirements in Section 9-14.4(3). Compost shall be Type 2 in accordance with Section 9-14.4(8).

Refer to WSDOT Standard Plans I-5 & I-14 in Section 4

Additional Information

- Pipe slope drains may be needed to convey water that accumulates along the filter berm to prevent blowouts.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.6 Storm Drain Inlet Protection

Definition

Storm drain inlet protection is a concept where sediment is trapped internally or externally of the catch basin. Prefabricated devices are available for both situations.

Purpose

Inlet protection is often the last opportunity to minimize sediment impact to an receiving water body.

WSDOT Specification

2004 Standard Specifications
8-01.3(9)D Inlet Protection
Inlet protection can be performed below and above the inlet grate, or as a cover. All devices shall be installed prior to clearing, grubbing or earthwork activities and shall be as shown in the Plans. Geotextile fabric in all prefabricated inlet protection devices shall meet or exceed the requirements of Table 1 for Moderate Survivability, and the minimum filtration properties of Table 2, in Section 9-33.2. When the depth of accumulated sediment and debris reaches approximately one-half the height of an internal device or one-third the height of the external device (or less when so specified by the manufacturers), the deposits shall be removed and stabilized on site.

8-01.3(9)E Below Inlet Grate
These devices shall be prefabricated units specifically designed for inlet protection and shall remain securely attached to the drainage structure when fully loaded with sediment and debris, or at the maximum level of sediment and debris specified by the manufacturer.

8-01.3(9)F Above Inlet Grate

These devices may be silt fence or prefabricated units specifically designed for inlet protection having the following features: The device shall remain securely in place around the drainage structure under all conditions.

8-01.3(9)G Inlet Grate Cover
These devices shall be prefabricated units specifically designed for inlet protection and have the following features:

1. Be a sewn geotextile fabric unit fitted to the individual grate and completely enclosing the grate.
2. Have built-in lifting devices to allow manual access of the stormwater system.
3. Utilize an orange monofilament geotextile fabric.

Check dams or functionally equivalent devices may be used as inlet protection devices with the approval of the Engineer.

Refer to WSDOT Standard Plans I-6 & I-7 in Section 4

Additional Information

- There is a difference in how internal and external inlet protection devices function.
- Internal devices tend to consist of a non-woven material that is semi-porous. Larger sediments are trapped, but silt and clay sized particles pass through. They are most appropriate in situations where roadway flooding is a concern or construction traffic will damage an external device.
- External devices may be prefabricated or assembled in the field using silt fence. Both trap sediment by creating a ponding area surrounding the inlet. The reduced velocities allow sediment to settle. This process allows external devices to be more efficient at trapping greater volumes of sediment of smaller size.
- The above mentioned inlet protection devices are preferred, however in an emergency, berms of sand bags or washed gravel can be placed around the inlet.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.7 Sediment Trap

Definition

A temporary area using natural depressions or excavated ponds to trap sediment.

Purpose

To collect sediment from concentrated flows and encourage runoff infiltration.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- Trap efficiency is enhanced when runoff is passed through additional sediment control BMPs.
- Sediment traps do not have to be an engineered structure, however, prior to implementing this BMP, consult with the WSDOT inspector or engineer.
- Sediment traps and ponds are limited to removing medium sized sediment.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.8 Temporary Sediment Pond

Definition

A temporary basin with a controlled stormwater release structure.

Purpose

To collect stormwater runoff and detain it long enough to trap sediment and allow infiltration.

WSDOT Specification

2004 Standard Specifications
8-01.3(1)D Detention/Retention Pond Construction
When a detention or retention pond is required, whether it is temporary or permanent, it shall retain/detain the full final design volume of stormwater before beginning other grading and excavation work in the area that drains into that pond. Temporary conveyances shall be installed concurrently with grading in accordance with the TESC plan so that newly graded areas drain to the pond as they are exposed.

Additional Information

- Use of infiltration facilities for sedimentation basins during construction may clog the soils and reduce their capacity to infiltrate.
- If the sediment pond is at final grade a pretreatment structure will minimize the clogging affects of the fine sediments.

- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.9 Construction Stormwater Chemical Treatment

Definition The use of a chemical to encourage flocculation of fine sediments within construction site runoff.

Purpose To reduce the turbidity of stormwater runoff. The addition of flocculants improves a detention ponds ability to remove the fine sediments it otherwise could not by gravity alone.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.

Additional Information

- This process is sometimes used in conjunction with stormwater filtration (refer to 3.4.11).
- Due to the small size, shape, and weight of fine particles, such as silt and clay, conventional methods are largely ineffective at removing these particles from construction site runoff.
- Deterrents to the wide spread usage of chemical stormwater treatment include:
    1. It is not cheap.
    2. A special permit is required from the Washington State Department of Ecology.
    3. Adjustment to the treated water pH may be necessary.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

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3.5.10 Construction Stormwater Filtration

Definition

The use of filters to remove sediment from construction site stormwater. The process of pumping construction stormwater through a series of filters, primarily sand. Many of these systems are mobile and can be setup on any construction site.

Purpose

To remove sediment from construction site stormwater ponds.

WSDOT Specification

No WSDOT Standard Specification exists; therefore, a special provision must be written.
Additional Information

- Unlike chemical treatment, the use of construction stormwater filtration does not require approval from Ecology.
- Two types of filtration systems may be applied to construction stormwater treatment: rapid and slow. Rapid sand filters are the typical system used for water and wastewater treatment. They can achieve relatively high hydraulic flow rates, on the order of 2 to 20 gpm/sf, because they have automatic backwash systems to remove accumulated solids. In contrast, slow sand filters have very low hydraulic rates, on the order of 0.02 gpm/sf, because they do not have backwash systems. To date, slow sand filtration has generally been used to treat stormwater. Slow sand filtration is mechanically simple in comparison to rapid sand filtration but requires a much larger filter area.
- **Filtration Equipment.** Sand media filters are available with automatic backwashing features that can filter to 50 µm particle size. Screen or bag filters can filter down to 5 µm. Fiber wound filters can remove particles down to 0.5 µm. Filters should be sequenced from the largest to the smallest pore opening. Sediment removal efficiency will be related to particle size distribution in the stormwater.
- **Treatment Process Description.** Stormwater is collected at interception point(s) on the site and is diverted to a sediment pond or tank for removal of large sediment and storage of the stormwater before it is treated by the filtration system. The stormwater is pumped from the trap, pond, or tank through the filtration system in a rapid sand filtration system. Slow sand filtration systems are designed as flow through systems using gravity.
- If large volumes of concrete are being poured, pH adjustment may be necessary.
- Filtration may also be used in conjunction with polymer treatment in a portable system to assure capture of the flocculated solids.
- Maintenance – Refer to WSDOT Standard Specification for Maintenance at the end of section 3.5.

Notes _____

WSDOT Standard Specification for Maintenance

2004 Standard Specifications
8-01.3(15) Maintenance
Erosion control devices shall be maintained so they properly perform their function until the Engineer determines they are no longer needed. The devices shall be inspected on the schedule outlined in Section 8-01.3(1)B for damage and sediment deposits. Damage to or undercutting of the device shall be repaired immediately.

Section 4

4.1 Overview and TESC Plan Requirements

4.1.1 Purpose of a TESC Plan

Washington State Department of Transportation (WSDOT) requires Temporary Erosion and Sedimentation Control (TESC) plans on all construction projects that add or replace (removal of existing road surface down to base course) more than 2,000 square feet of impervious surface or disturb more than 7,000 square feet of soil. Projects that disturb less than 7,000 square feet of soil must address erosion control, but a stand-alone TESC plan is optional. An effective erosion control plan saves both time and money, and thus allows WSDOT to fulfill its responsibility to build highways in both fiscally and environmentally responsible manners.

The purpose of TESC planning is to clearly establish when, where, and how specific BMPs will be implemented to prevent erosion and the transport of sediment from a site during construction. TESC planning is used to identify potential problems and to provide solutions to eliminate or minimize the risk of erosion. It should indicate what BMPs will be implemented in the design of the project as well as the procedures used during construction to minimize erosion. Due to the unpredictable nature of weather and construction conditions, an erosion control plan must be flexible and open to modifications or additions during construction.

The principal focus of an effective TESC plan should be erosion control. Although every plan will contain both erosion and sedimentation control measures, it is more cost effective to emphasize erosion prevention. Erosion prevention should be considered in both the design and construction planning processes as well as during construction. Properly implemented erosion control BMPs prevent site damage and water quality problems that sedimentation control measures can at best only partially remedy.

4.1.2 Plan Elements

A standard WSDOT TESC plan includes a narrative section, a set of site plans, and descriptions for meeting the 12 minimum requirements as described in the WSDOT Highway Runoff Manual. All minimum requirements must be considered during the planning process, although not all requirements are applicable on every project. The TESC Minimum Requirements are:

- Element 1: Mark clearing limits
- Element 2: Establish construction access
- Element 3: Control flow rates
- Element 4: Install sediment controls
- Element 5: Stabilize soils
- Element 6: Protect slopes

Table 4.2.3.B
TESC FIELD CHECKLIST, continued

- Element 7: Protect drain inlets
- Element 8: Stabilize channels and outlets
- Element 9: Control Pollutants
- Element 10: Control dewatering
- Element 11: Maintain BMPs
- Element 12: Manage the project

4.2 The Contractor's Role in TESC Planning

4.2.1 WSDOT Prepares Initial Plan

WSDOT prepares an initial erosion control plan for all projects involving soil disturbances. These plans are prepared in advance to satisfy permit requirements for project approval. Important TESC planning details cannot be included in the initial plan because construction dates, methods and schedules are frequently determined by the contractor.

4.2.2 Contractor Modifies Plan at Pre-construction Meeting

Because contractors determine the construction methods and schedule, contractors are required to modify the TESC plan so that it is compatible with their construction plans. The contractor should prepare TESC plan modifications for presentation at the Pre-construction Meeting. Modifications should describe: 1) how the construction schedule will minimize site exposure to erosion, 2) how TESC BMP installation will correspond to the construction schedule, 3) how and where the proposed erosion and sedimentation control measures will stabilize disturbed soils, divert or store flows, and retain sediments throughout each phase of construction, 4) how and when the TESC measures will be replaced or converted into permanent stormwater management BMPs, and 5) the schedule and procedures for monitoring and maintaining the erosion and sedimentation control measures.

4.2.3 TESC Plan Implementation

The contractor must identify an ESC Lead at the pre-construction meeting and the Lead is responsible for implementing the TESC plan throughout construction. This includes installing and maintaining the BMPs, performing the BMP inspections (see Table 4.2.3A – sample inspection form), maintaining the TESC file with current plans and inspection

reports, and working with the WSDOT Engineer. Implementing the plan often includes making modifications in the field and the ESC Lead must coordinate with the WSDOT Engineer to modify the plan as needed.

The WSDOT engineer or inspector will conduct frequent site inspections to confirm that the contractor is implementing the plan and that the plan is working effectively. The WSDOT

Table 4.2.3.B
TESC FIELD CHECKLIST, continued
inspector will walk the site with the TESC plan in hand to evaluate whether BMPs were installed as specified on the plan drawings. Inspections will be made on a regular basis to ensure that the site is always prepared for a storm. The inspector may use a tool such as the TESC Field Checklist to evaluate whether BMPs have been installed properly and are effective (see Table 4.2.3B). It is also valuable to the ESC Lead to assess the effectiveness of the site BMPs, and record inspection details.

When the ESC Lead becomes aware of a problem on the site, the WSDOT Engineer must be notified. The WSDOT Engineer will determine if the problem warrants notifying the regulatory authorities.

Table 4.2.1 TESC Field Checklist

WSDOT – ESC Lead

Project Title: _____

Contact # _____

Project Location/Region: _____

Name: _____

Indicate whether or not the project is meeting the Minimum Requirements (if applicable) for erosion control.
If the project is not meeting any Requirements, indicate on back the corrective actions required/taken.

	Yes	No
1. Mark Clearing Limits		
Are the limits of clearing and grading clearly marked with barrier fencing?		
2. Establish Construction Access		
Is a stabilized construction entrance or wheel wash present and preventing trackout?		
3. Control Flow Rates		
Is there any stormwater leaving the site and does the discharge meet State Water Quality Standards?		
Is sediment being deposited on adjacent properties or waterways?		
If no, what is the turbidity of site discharge and of receiving water?		
4. Install Sediment Controls		
Are detention ponds installed to trap sediment from site runoff?		
Are side slopes and outfalls of detention pond(s) stabilized?		
Are sediment trapping BMPs (sediment traps, check dams, silt fences, etc.) in place?		

Table 4.2.3.B
TESC FIELD CHECKLIST, continued

	Yes	No
5. Stabilize Soils		
Are erodible soils stabilized? (seed, mulch, erosion blankets, plastic, construction entrance, etc.)		
6. Protect Slopes	Yes	No
Are exposed cut and/or fill slopes stabilized and protected from concentrated flows?		
If there are groundwater seeps or springs, are the appropriate BMPs in place to dewater them (pipe slope drains, interceptor swales, dewatering wells)?		
7. Protect Drain Inlets	Yes	No
Are all storm drains onsite being protected with functioning temporary inlet protection devices?		
8. Stabilize Channels and Outlets	Yes	No
Are temporary conveyance channels adequately stabilized?		
Are conveyance channel outlets adequately stabilized?		
Is the site discharge contributing to offsite erosion?		
9. Control Pollutants	Yes	No
Are pollutants, including construction materials handled and disposed of in a manner that does not cause contamination of stormwater?		
10. Control De-watering	Yes	No
Is the groundwater treated in a way that optimizes overall site water quality?		
11. Maintain BMPs	Yes	No
Have the temporary BMPs been removed in areas that are completely stabilized?		
Are BMPs adequately maintained?		
12. Manage the Project	Yes	No
Is the TESC plan on-site and easily obtainable?		
Is the Contractor and WSDOT Erosion Lead clearly identified in the TESC plan?		
Is the contractor completing weekly BMP inspection forms and keeping records?		

Problems/Corrective Actions:

Table 4.2.3.B
TESC FIELD CHECKLIST, continued

4.3 Types of BMPs

There are three types of erosion prevention BMPs that must be considered in TESC planning: design, procedural, and physical. An effective erosion control plan will address each of these BMP types. BMP selection should be based on preventing erosion rather than the treatment of turbid runoff as the result of erosion.

4.3.1 Design BMPs

A project design that minimizes erosion control risks results in reduced erosion complications during and after construction. All possible measures should be utilized to minimize clearing and grading which exposes the site to erosion. Projects should be designed to integrate existing land contours as much as possible and minimize the angle and lengths of slopes. Project drainage design should consider water generated both on and off of the site that can impact erosion potential.

Table 4.3.1 Examples of Design BMPs in Relation to TESC Elements

BMP	**Element Addressed** (partially)
Minimize clearing and grading	All TESC Elements
Integrate existing land contours; minimize slope angle and length	#6 Protect Slopes
Design drainage to account for on-site and off-site water sources	#4 Install Sediment Controls #3 Control Flow Rates #8 Stabilize Channels & Outlets
Design dewatering system that maintains water quality	#10 Control Dewatering
Slope roadway or add curbs to keep runoff away from steep slopes, provide adequate detention and outlet protection	#3 Control Flow Rates #6 Protect Slopes

4.3.2 Procedural BMPs

How and when a project is built can greatly affect the potential for erosion. Sequencing and scheduling are some of the most important aspects of erosion control planning. Construction sequencing should minimize the duration and extent of soil disturbance. Whenever possible, major soil disturbing activities should be done in phases to minimize exposed areas. Likewise, major grading operations should be limited to the dry season.

An effective schedule prevents the site from becoming overexposed to erosion risks. The construction schedule should tie the installation of erosion control BMPs to the order of land disturbing activities. The types of activities that should be included in the schedule are:

- Installation of perimeter control and detention BMPs prior to soil-disturbing activities
- Phasing and timing of clearing, grubbing, and grading

- Interim BMP strategies
- Installation of permanent BMPs and a description of how temporary BMPs have been coordinated with the development of permanent measures
- Erosion control inspection and maintenance schedule

Table 4.3.2 Examples of Procedural BMPs Related to TESC Elements

BMPs	TESC Elements Affected
Schedule soil-disturbing activities in phases to limit open areas. Limit soil-disturbing activities to dry season.	All minimum requirements
Require implementation of unworked soils: October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days; from May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days.	#4 Install Sediment Controls #5 Stabilize Soils
Mark clearing limits, sensitive areas, and buffers.	#1 Mark Clearing Limits #3 Control Flow Rates
Install detention pond and perimeter control BMPs prior to grading.	#3 Control Flow Rates #4 Install Sediment Controls
Phase construction of cut and fill slopes, build using terraces, cover as completed, route water away from slope.	#6 Protect Slopes #12 Manage The Project
Provide conveyances and adequate detention, and stabilized outfall BMPs prior to major earthwork.	#3 Control Flow Rates
Install stable conveyances to direct runoff to detention facilities as areas are cleared.	#3 Control Flow Rates #8 Stabilize Channels & Outlets #12 Manage The Project
Divert clean water running onto the site around construction.	#8 Stabilize Channels & Outlets
Require physical inlet protection BMPs.	#7 Protect Drain Inlets
Limit traffic to construction accesses and haul roads.	#2 Establish Construction Access
Require dewatering to discharge water in a manner that does not impact receiving waters. Infiltrate whenever possible.	#9 Control Dewatering #3 Control Flow Rates
Require inspection and maintenance of BMPs.	#11 Maintain BMPs

4.3.3 Physical BMPs

Physical BMPs include all of the erosion and sediment control measures that are put in place after all possible design and procedural BMPs have been considered. Physical BMPs should be considered as a supplement to and not a replacement for the design and procedural BMPs. Some examples are listed in Table 4.3.3 and described in Section 3 of this manual, the *Highway Runoff Manual*, and the *Washington State Department of Ecology Stormwater Management Manual for Western Washington.*

Table 4.3.3 Physical BMPs and Related TESC Elements

BMP	TESC Element Affected
Stabilization Temporary Seeding of Stripped Areas, Mulching and Matting Plastic Covering, Preserving Vegetation, Buffer Zone, Permanent Seeding and Planting, Sodding, Topsoiling, Polyacrylamide for Soil Erosion Protection, Surface Roughening **Sediment trapping** Filter Fence, Straw Bale Barrier, Brush Barrier, Gravel Filter Berm, Sediment Trap, Temporary Sediment Pond, Construction Stormwater Chemical Treatment**,** Construction Stormwater Filtration	#4 Install Sediment Controls #5 Stabilize Soils
Preserving Natural Vegetation, Buffer Zones, Plastic or Metal Fence, Stake and Wire Fence	#1 Mark Clearing Limits
Sediment Trap, Temporary Sediment Pond	#3 Control Flow Rates
All BMPs for Elements #4 & 5 plus Interceptor Dike and Swale, Pipe Slope Drains, Gradient Terraces	#6 Protect Slopes
Preserving Vegetation, Buffer Zone, Temporary Sediment Pond, Outlet Protection**,** Vegetated Strip	#3 Control Flow Rates
Grass-Lined Channel, Riprap Channel Lining Check Dams, Triangular Silt Dike (Geotextile Fabric Check Dam), Outlet Protection	#8 Stabilize Channels & Outlets
Storm Drain Inlet Protection	#7 Protect Drain Inlets
Stabilized Construction Entrance, Wheel Wash, Construction Road/Parking Area Stabilization	#2 Establish Construction Access
Sediment Trap, Temporary Sediment Pond, Construction Stormwater Chemical Treatment, Construction Stormwater Filtration	#10 Control Dewatering

4.4 Physical BMP Selection

Selection of the appropriate physical erosion control BMPs is a crucial component of TESC planning and implementation. Properly installed and maintained physical BMPs can greatly reduce erosion where design and procedural BMPs have been implemented. Conversely, physical BMPs alone cannot adequately prevent erosion or water quality violations if design or procedural BMPs are not employed. Table 4.4 aids in the selection of BMPs. The table includes common potential erosion control and sediment problems, and selection criteria for physical BMPs to address the problems. When multiple BMPs can be used to correct the same problem, consult Section 3 for more information on individual BMPs.

When selecting BMPs it is important to correctly identify the source of the problem. It is better to treat the source once than constantly battle with the symptoms downgradient; i.e., cover a slope once as opposed to fixing a silt fence ten times. Misidentification of the source of the problem often leads to wasting of time, material and money on inappropriate and ineffective measures.

Table 4.4 Physical Control BMP Selection Guide Based on Potential Problems

Potential Problem (Reminder: all erosion BMPs help prevent sediment problems)	**Recommended BMPs**
Erosion due to rainfall on exposed soils	Preserving Vegetation, Track Walking, Mulching, Blankets/ Mats, PAM, Temporary Seeding, Bonded Fiber Matrix, Plastic, Sodding, Topsoiling, Permanent Seeding and Planting
Erosion due to rainfall on short or low gradient exposed slopes	Preserving Vegetation, Track Walking, Mulching, Blankets/ Mats, PAM, Temporary Seeding, Bonded Fiber Matrix, Plastic, Sodding, Topsoiling, Permanent Seeding and Planting
Erosion due to long or steep exposed slopes	Preserving Vegetation, Track Walking, Gradient Terraces, Mulch, Blankets/Mats, PAM, Temporary Seeding, Bonded Fiber Matrix, Plastic, Sodding, Topsoiling, Permanent Seeding and Planting Conveyance – Interceptor Dike and Swale, Pipe Slope Drains
Erosion due to concentrated runoff from impervious surfaces flowing onto exposed slopes	Interceptor Dike and Swale, Pipe Slope Drains
Erosion due to offsite water running onto exposed slopes as either concentrated flow or sheet runoff	Pipe Slope Drains, Interceptor Dike and Swale
Erosion in ditches due to high velocity flows	Check Dams, Sodding, Matting, Rip-Rap Channel Lining, Level Spreader
Sediment-laden water leaving the site as sheet flow	Silt Fence, Straw Bale Barrier, Brush Barrier, Gravel Filter Berm

Potential Problem (Reminder: all erosion BMPs help prevent sediment problems)	Recommended BMPs
Sediment–laden water entering the storm drain	Drain Inlet Protection (above/below the grate and covers), Stabilized Construction Entrance & Tire Wash, Construction Road Stabilization, Early First Asphalt Lift or Gravel Bedding in Areas to be Paved
Sediment-laden water leaving the site as concentrated flow	Infiltration, Sediment Trap, Temporary Sediment Pond, Outlet Protection, Chemical Stormwater Treatment
Tracking of sediment onto roadways	Stabilized Construction Entrance & Tire Wash, Street Sweeper, Early First Asphalt Lift or Gravel Bedding in areas to be paved, Maintenance of Construction Entrance
Discharges of concentrated, high velocity flows causing erosion	Level Spreader, Temporary Sediment Pond, Outlet Protection
[a] When a variety of alternative BMPs can be used to solve a particular problem, refer to the Highway Runoff Manual and Ecology's Stormwater Management Manual for guidance to select the preferred BMP.	

4.5 Standard Specifications

The ability to enforce provisions in the TESC plan is directly tied to the contract. Contracts must be written so they ensure the TESC minimum requirements of the plan are addressed throughout construction. The contractual tools for ensuring that the plan is properly enforced include the *Standard Specifications for Road Bridge and Municipal Construction*, General Special Provisions (statewide and region specific), Special Provisions, and Standard Plans.

The *2004 Standard Specifications* have been revised with regard to erosion control issues to do a better job of meeting the 12 required elements within a TESC plan. However, in some cases they are still deficient and must be supplemented with General Special Provisions or Special Provisions to ensure that issues concerning erosion control are addressed in the contract language. In many instances, erosion control issues are best addressed using other contractual tools because they are too specific to be written as Standard Specifications. Table 4.5 presents a summary of some TESC issues with the corresponding Standard Specifications related to erosion and sediment control. When the Standard Specifications do not meet a specific erosion control requirement, General Special Provisions or Special Provisions are added to the contract.

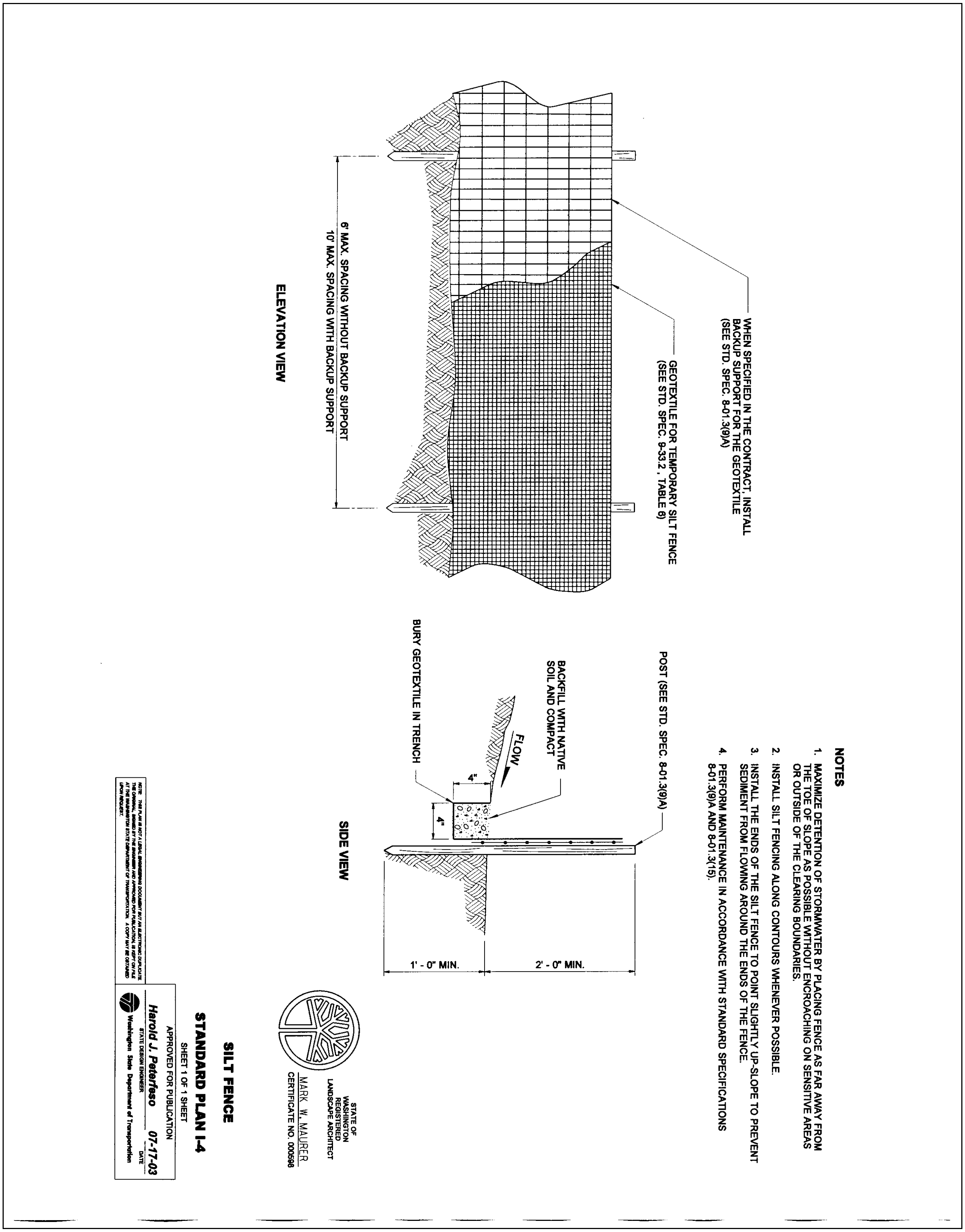
Table 4.5 Standard Specifications & Standard Plans Related to Erosion and Sedimentation Control

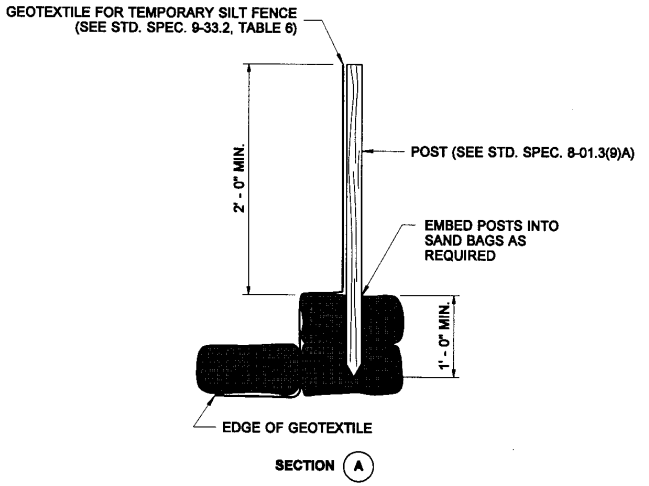
Issue	Corresponding Specification[a] and/or Standard Plan	Comments
Limiting soil exposure area	8-01.3(1) "Clearing, grubbing, excavating, borrow, or fill within the right of way shall never expose more erodible earth than as listed below, without written approval by the Engineer:" 17 Acre: Apr. 1 – Oct. 31 East of the summit of the Cascade Range May 1 – Sep. 30 West of the summit of the Cascade Range 5 Acre: Nov. 1 – Mar. 31 East of the summit of the Cascade Range Oct. 1 – Apr. 30 West of the summit of the Cascade Range	Exposing too much soil for long periods is the leading cause of erosion damage and water quality violations. This specification assures that decisions regarding clearing and grubbing larger areas are made at WSDOT's discretion. Specials provisions may be required on 1) high risk sights/areas where tighter limits necessary, and 2) low risk site, where it may be advantageous to clear and grub larger areas at once.
Limiting soil exposure duration	8-01.3(1) In western Washington, erodible soil not being worked whether at final grade or not, shall be covered within the following limitations, using an approved soil covering practice, unless authorized by the Engineer:" October 1 – April 30 2 days maximum May 1 – September 30 7 days maximum	The soil cover requirements are conditions of the NPDES permits for Western Washington. A General Special Provision is being written for eastern Washington and should be available by January 2004.
Timing of sediment control BMP installation Elements #3 & #4	8-01.3(1)A Schedule required as part of TESC plan 8-01.3(1)D "When a detention or retention pond is required, whether it is temporary or permanent it shall be fully functional before beginning other grading and excavation work." 8-01.3(9) Sediment Control Barriers.	One of the most common contributing factors to violations is not having the detention pond in as a first step in grading.
Keep roadways clean	1-07.23(1) The Contractor shall…maintain existing roads and streets within the project limits (and adjacent streets-mentioned later) keeping them open, and in good clean, safe condition at all times. 8-01.3(8) Street Cleaning 8-01.3(6) Stabilized Construction Entrance / Standard Plan I-14	1.-07.23(1) focuses on keeping roads safe for the public. 8-01.3(8) Roads must be clean enough to make sure that runoff meets State water quality standards. Additional sweeping may be required for road surfaces that are not open to the traveling public if accumulation of soil impacts the turbidity of stormwater runoff.
Ditch lining Element #8	2-12.3(4) Describes geotextile installation methods and how to secure it with rip-rap. 8-01.3(3) Describes Erosion Control Blanket Installation / Standard Pan I-13 9-14.5 Erosion Control Blanket material Specifications 9-33.2 Tables 4 and 5 Geotextile Material Specifications	The Construction Site Erosion and Sediment Control Certification Course provides guidance for calculating sheer stress. See referenced database below for selecting products.
Slides during construction	2-03.3(11) "If the Contractor undercuts or destroys a slope, or has failed to implement erosion control devices as shown in the Contract, in the TESC plan, or as directed by the Engineer, it shall be resloped to the original alignment or to a new one established by the Engineer at no expense to the Contracting Agency." 8-01.3(1) "If natural elements rut or erode the slope, the Contractor shall restore and repair the damage"	The contractor pays to fix any slope damage resulting from their action or neglect. WSDOT pays for the contractor to repair slopes that are otherwise damaged.

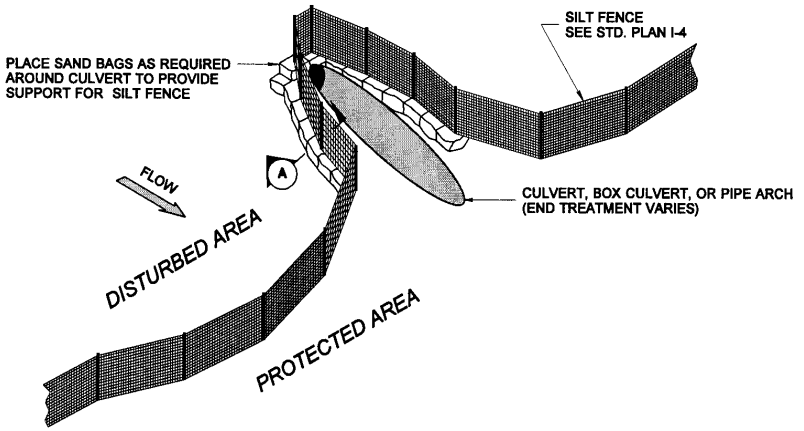
Issue	Corresponding Specification[a] and/or Standard Plan	Comments
Dewatering Element #10	8-01.3(1) C Groundwater encountered on the site may be handled in 3 ways depending on the turbidity of the groundwater. If it meets State Water Quality Standards, it may be routed directly offsite. If the turbidity is similar to the site stormwater, it may be treated using the same detention and treatment facilities as onsite stormwater. If the turbidity is worse than the site stormwater, it must be detained and treated separately prior to mixing it with stormwater.	If groundwater is not isolated from stormwater, groundwater will overwhelm the capacity of the stormwater detention system causing it to be ineffective.
Erosion Control Blanket Placement	8-01.3(3) Describes Erosion Control Blanket Installation / Standard Plan I-12 9-14.5(2) Erosion Control Blanket material Specifications. Temporary and permanent	Make sure that the proper blanket type is selected for temporary and permanent based on 9-14.5 specifications. Refer to the product database at http://www.wsdot.wa.gov/eesc/environmental/programs/hazwqec/wqec.htm.
Check dams	8-01.3(6) Describes timing and installation specs for check dams in general. 8-01.3(6)A Geotextile-Encased Check Dam installation specs / Standard Plan I-10 8-01.3(6)B Rock Check Dam installation specs / Standard Plan I-11 8-01.3(6)C Sandbag Check Dam installation specs / Standard Plan I-11 8-01.3(6)D Wattle Check Dam / Standard Plan I-11	Properly placed check dams will prevent erosion and increase settling capacity within conveyance channels. Check dams should be spaced such that the toe of the upstream check dam is even with the top of downstream check dam.
Silt Fences	8-01.3(9)A Describes specific installation guidelines / Standard Plan I-4 & I-5 9-33.2 Table 6 Geotextile for temporary silt fence	Silt fences are very effective when properly located. Do not install in the path of concentrated flows. Proper installation and maintenance are essential.
Straw bale barrier	8-01.3(9)C Describes Installation Specs / Standard Plan I-9	Performs similar to silt fence. Not to be confused with straw bale check dams.
Gravel filter berm, wood chip, or compost berm	8-01.3(9)B Describes Installation Specs /Standard Plan I-5 & I-14	Gravel filter berms can be graded out onto road shoulders when project is complete. Wood chip and compost berms can be spread out as erosion control mulch when no longer necessary.
Storm drain inlet protection	8-01.3(9)D Inlet protection 8-01.3(9)E Below the Grate / Standard Plan I-7 8-01.3(9)F Above the Grate / Standard Plan I-6 8-01.3(9)G Inlet Grate Cover	Inlet protection devices require regular maintenance to ensure proper function. External devices detain water longer, providing better treatment. However, external devices cannot be used if they cause ponding on roadways that are open to the public.
PAM for soil binding	8-01.3(2)C Describes Polyacrylamide (PAM) specifications, application rates and procedures.	PAM is a very effective soil stabilizer but some restrictions may apply in certain areas. Contact the regional environmental office for details.
Stabilized construction entrance	8-01.3(7) Stabilized construction entrance shall be constructed in accordance with the Plans, prior to any clearing, grubbing, earthwork or excavation." /Standard Plan I-14	Best if located where the entrance slopes downward onto the site to prevent flushing of materials onto the roadway.
Tire Wash	8-01.3(7) Used in conjunction with stabilized construction entrance.	Tire wash water shall be treated and discharged with the approval of the Engineer..

Issue	Corresponding Specification[a] and/or Standard Plan	Comments
Pipe Slope Drains	8- 01.3(14) "Pipe slope drain shall be constructed in accordance with the Plans and shall meet the requirements of Section 9-05.1(6)."	Best professional judgment shall be used for selection of pipe size as site conditions influence decision.
None of the below Best Management Practices are described in Standard Specifications. All may require Special Provisions until the Standard Specifications are revised.		
Interceptor Dike and Swale	No Standard Specification exists.	A special provision must be written to address specific site requirements.
Level Spreader	No Standard Specification exists.	A special provision must be written to address specific site requirements.
Construction road stabilization	No Standard Specification exists.	A special provision must be written to address specific site requirements.
Sediment trap	No Standard Specification exists.	A special provision must be written to address specific site requirements.
[a] 2004 version of Standard Specifications for Roads Bridge and Municipal Construction.		

4.6 TESC Standard Plans



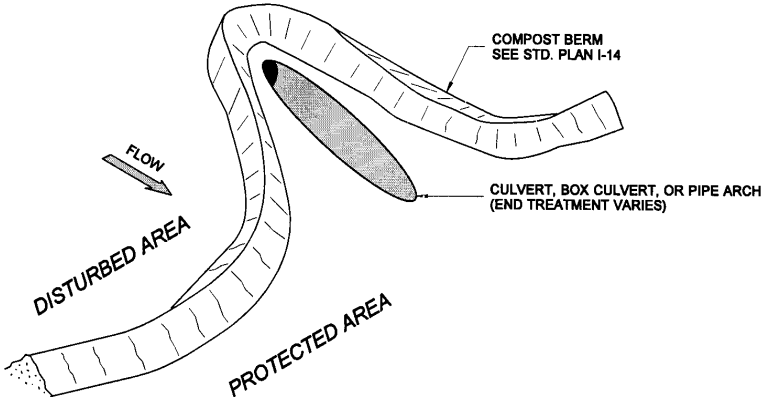




SILT FENCE DESIGN

NOTE

PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATIONS 8-01.3(9)A AND 8-01.3(15).



COMPOST BERM DESIGN

STATE OF WASHINGTON
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MARK W. MAURER
CERTIFICATE NO. 000598

EROSION CONTROL AT CULVERT ENDS

STANDARD PLAN I-5

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Harold J. Peterfeso 07-17-03

STATE DESIGN ENGINEER DATE

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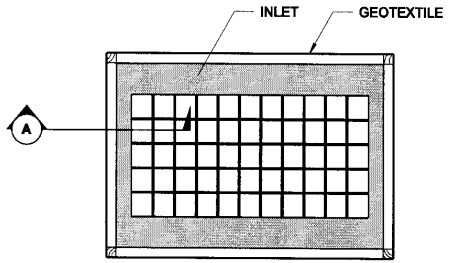
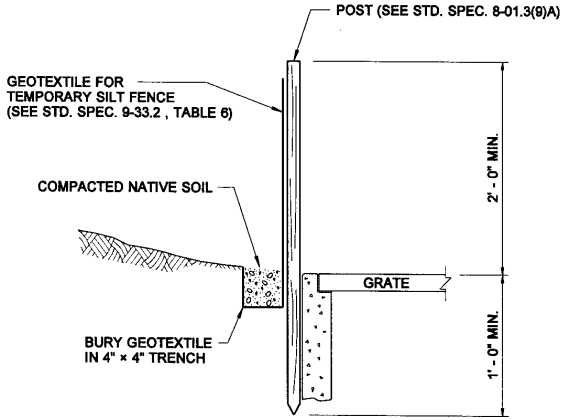


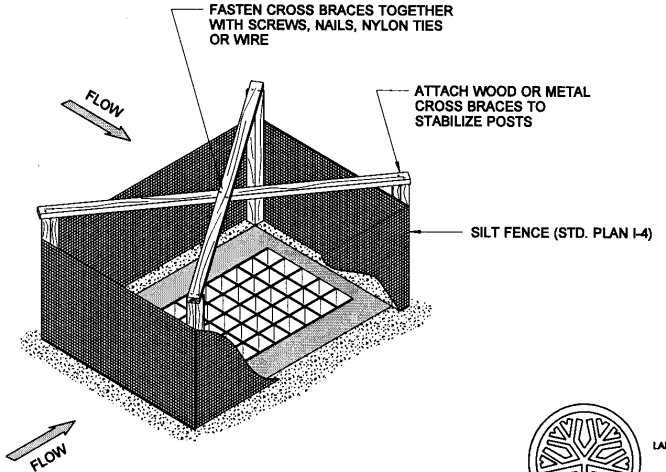
PLAN VIEW
(CROSS BRACES NOT SHOWN)



SECTION (A)

NOTES

1. PREFABRICATED UNITS MAY BE USED IN LIEU OF THE DESIGN SHOWN ON THIS PLAN UPON APPROVAL OF THE ENGINEER.
2. STRUCTURE SHALL BE CONSTRUCTED SUCH THAT GEOTEXTILE MATERIAL SHALL BE FASTENED TO POSTS CREATING A SEAMLESS JOINT.
3. ENSURE THAT PONDING HEIGHT OF WATER DOES NOT CAUSE FLOODING ON ADJACENT ROADWAYS OR PRIVATE PROPERTY.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).



ISOMETRIC VIEW
(ENTIRE FENCE NOT SHOWN
FOR ILLUSTRATIVE PURPOSES)

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TEMPORARY SILT FENCE FOR INLET PROTECTION IN UNPAVED AREAS
STANDARD PLAN I-6

SHEET 1 OF 1 SHEET

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STATE DESIGN ENGINEER DATE
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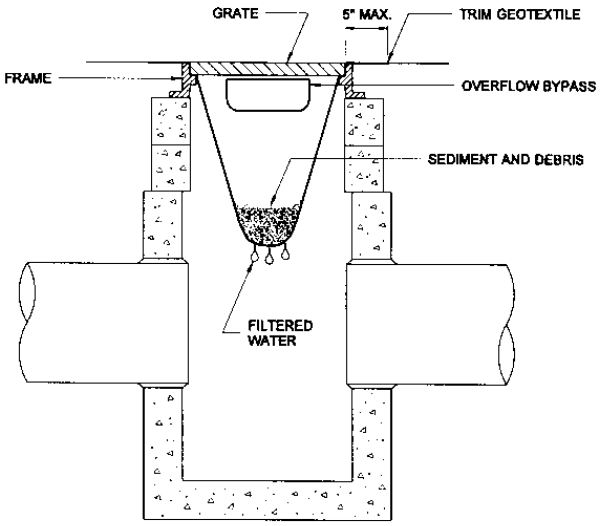
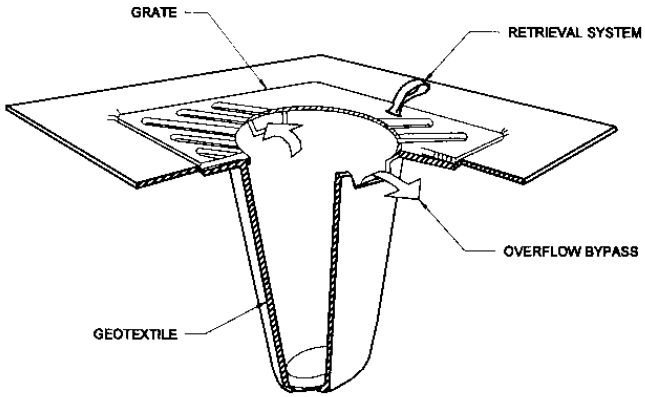


CROSS SECTION
NOT TO SCALE

NOTES

1. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).
2. SIZE THE BELOW GRATE INLET DEVICE (BGID) FOR THE STORM WATER STRUCTURE IT WILL SERVICE.
3. THE BGID SHALL HAVE A BUILT-IN HIGH-FLOW RELIEF SYSTEM (OVERFLOW BYPASS).
4. THE RETRIEVAL SYSTEM MUST ALLOW REMOVAL OF THE BGID WITHOUT SPILLING THE COLLECTED MATERIAL.



ISOMETRIC VIEW
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PREFABRICATED BELOW GRATE INLET DEVICE DETAILS

STORM DRAIN INLET PROTECTION

STANDARD PLAN I-7

SHEET 1 OF 1 SHEET

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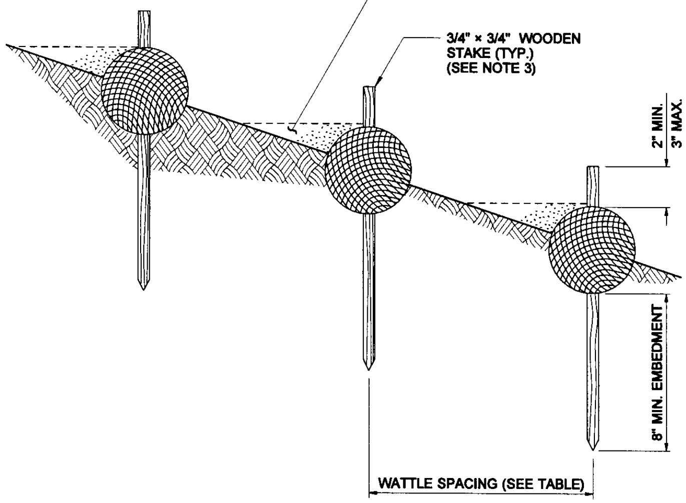


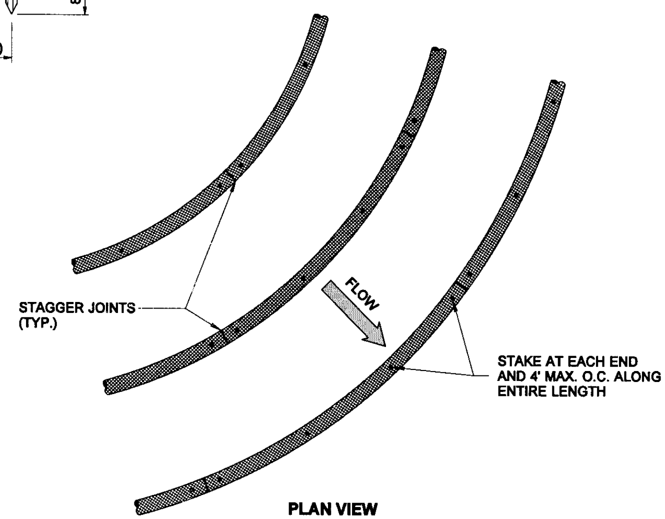
ELEVATION VIEW

NOTES

1. INSTALL WATTLES ALONG CONTOURS (SEE STANDARD SPECIFICATION 8-01.3(10)).
2. WATTLES SHALL BE INSPECTED REGULARLY, AND IMMEDIATELY AFTER A RUNOFF PRODUCING RAINFALL, TO ENSURE THEY REMAIN THOROUGHLY ENTRENCHED AND IN CONTACT WITH THE SOIL.
3. LIVE STAKES MAY BE USED FOR PERMANENT INSTALLATIONS.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).
5. INSTALL WATTLES SNUGLY INTO THE TRENCH. ABUT ADJACENT WATTLES TIGHTLY, END TO END, WITHOUT OVERLAPPING THE ENDS.
6. PILOT HOLES MAY BE DRIVEN THROUGH THE WATTLE AND INTO THE SOIL, WHEN SOIL CONDITIONS REQUIRE.

WATTLE SPACING TABLE

SLOPE	MAXIMUM SPACING
1:1	10 FEET
2:1	20 FEET
3:1	30 FEET
4:1	40 FEET



PLAN VIEW

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WATTLE INSTALLATION ON SLOPE

STANDARD PLAN I-8

SHEET 1 OF 1 SHEET

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Harold J. Peterfeso — STATE DESIGN ENGINEER — 07-17-03 DATE

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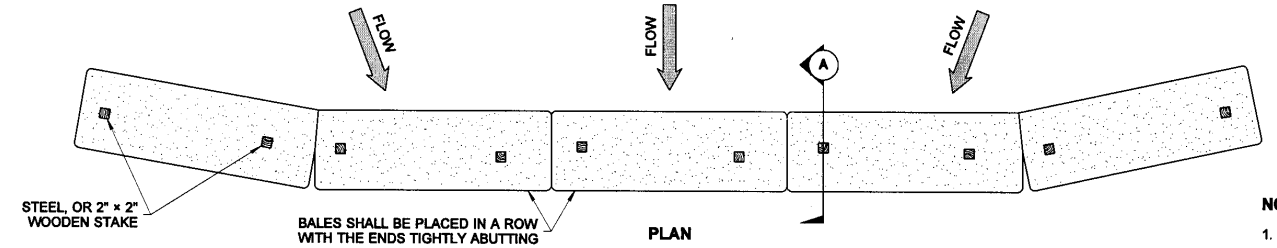
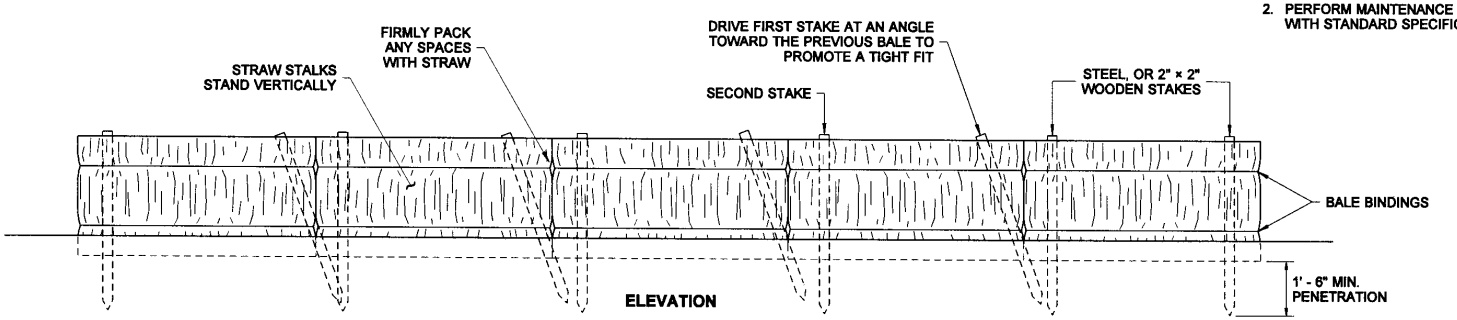


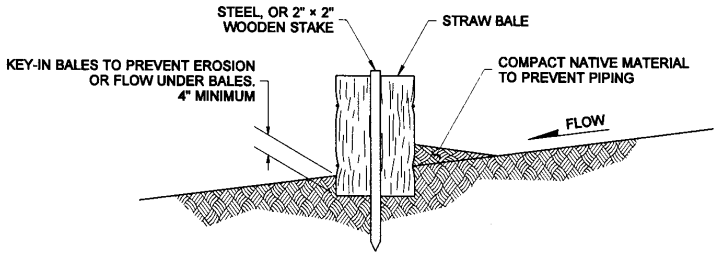
PLAN

NOTES

1. SEE STANDARD SPECIFICATION 8-01.3(9)D, FOR ADDITIONAL INFORMATION.
2. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).



ELEVATION



SECTION (A)

STATE OF WASHINGTON
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CERTIFICATE NO. 000598

STRAW BALE BARRIER

STANDARD PLAN I-9

SHEET 1 OF 1 SHEET

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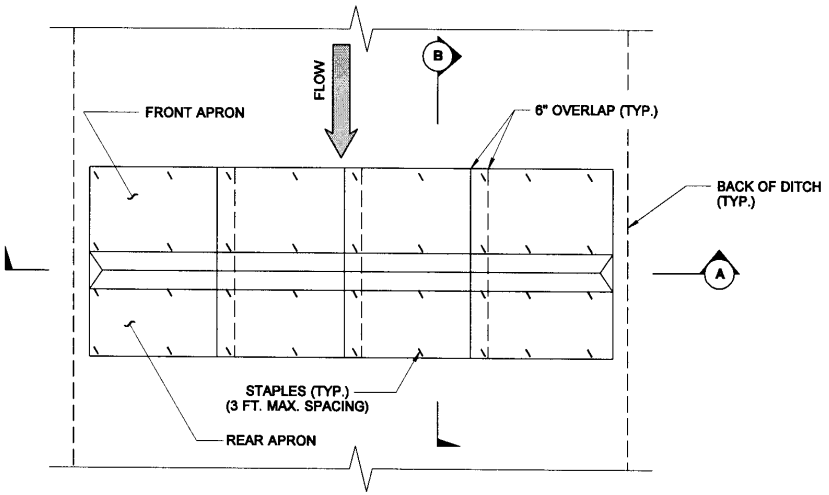
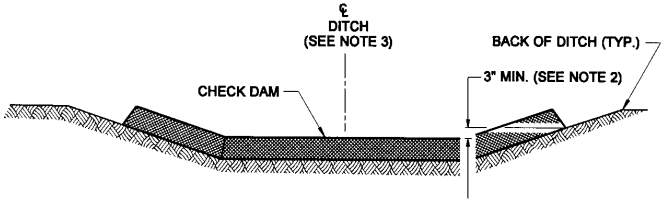


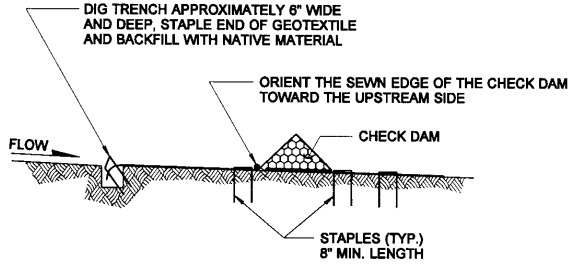
PLAN VIEW



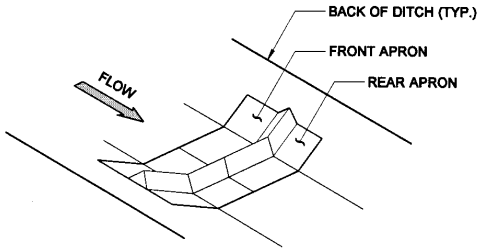
SECTION (A)

NOTES

1. GEOTEXTILE ENCASED CHECK DAMS SHALL MEET THE REQUIREMENTS OF STANDARD SPECIFICATIONS 8-01.3(5)A AND 9-14.5(4).
2. INSTALL THE SLOPED ENDS OF THE CHECK DAM A MINIMUM OF 3" HIGHER THAN THE TOP OF THE CHECK DAM IN THE CHANNEL TO ENSURE THAT WATER FLOWS OVER THE DAM AND NOT AROUND IT.
3. FLAT BOTTOM DITCH DESIGN SHOWN, CHECK DAM INSTALLATION DETAILS ARE SIMILAR FOR "V" BOTTOM DITCHES.
4. PERFORM MAINTENANCE IN ACCORDANCE WITH STANDARD SPECIFICATION 8-01.3(15).



SECTION (B)



ISOMETRIC VIEW

STATE OF WASHINGTON
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CERTIFICATE NO. 000598

GEOTEXTILE ENCASED CHECK DAM INSTALLATION
STANDARD PLAN I-10

SHEET 1 OF 1 SHEET

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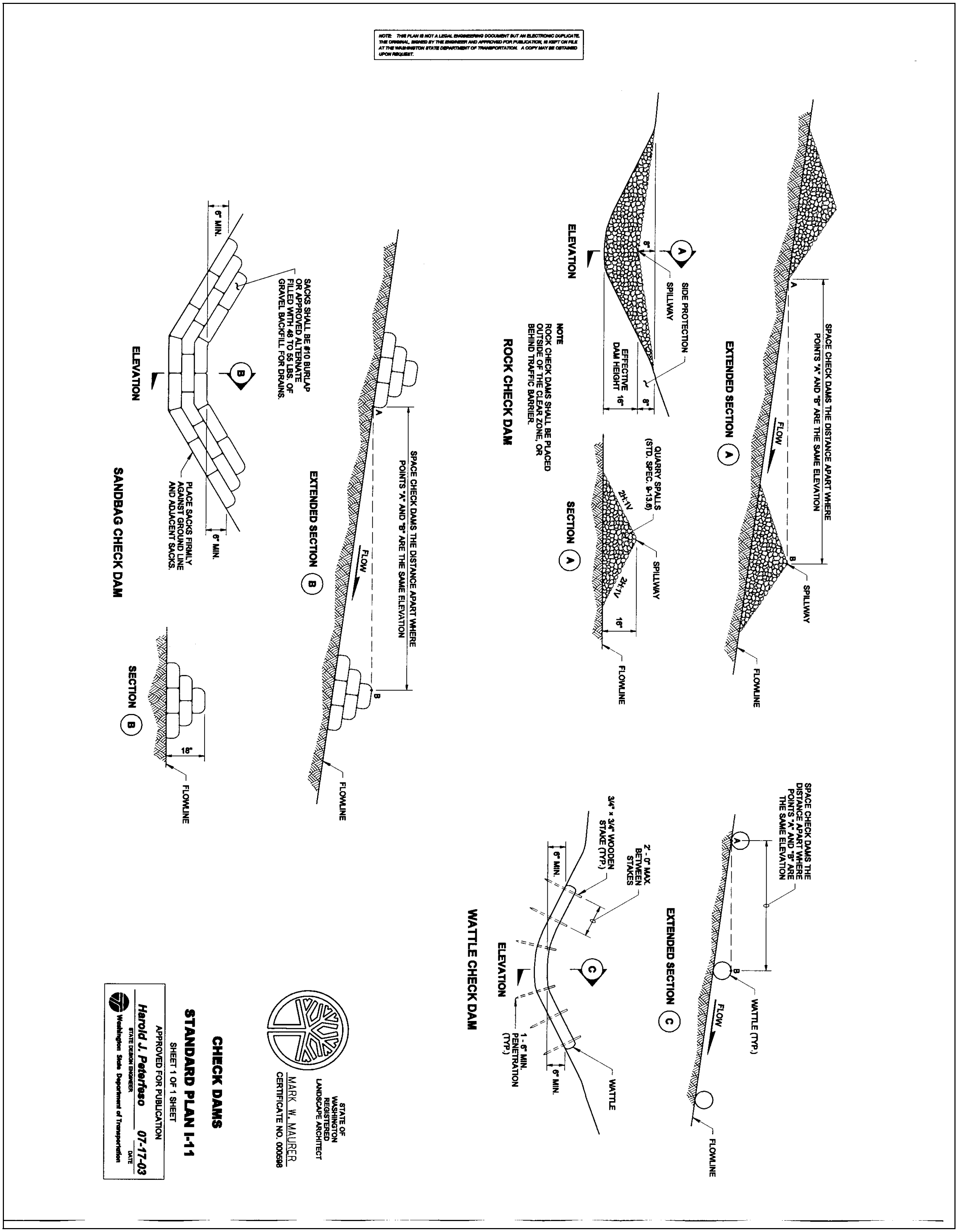
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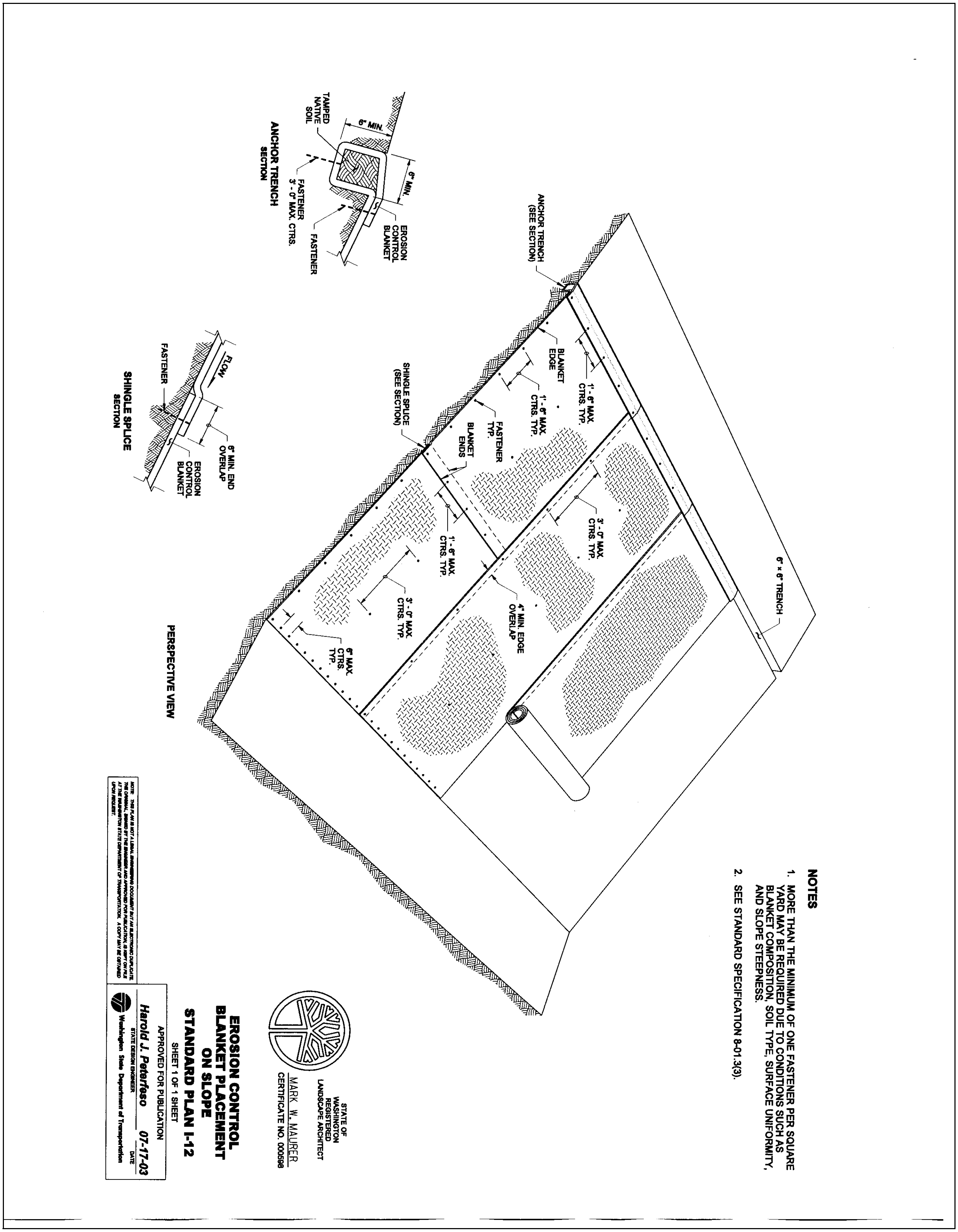
SPACE CHECK DAMS THE DISTANCE APART WHERE POINTS "A" AND "B" ARE THE SAME ELEVATION
SPILLWAY
FLOWLINE
FLOW
EXTENDED SECTION A
SIDE PROTECTION
SPILLWAY
EFFECTIVE DAM HEIGHT
16"
8"
8"
ELEVATION
QUARRY SPALLS (STD. SPEC. 9-13.6)
2H:1V
2H:1V
SPILLWAY
16"
FLOWLINE
SECTION A
NOTE
ROCK CHECK DAMS SHALL BE PLACED OUTSIDE OF THE CLEAR ZONE, OR BEHIND TRAFFIC BARRIER.
ROCK CHECK DAM
SPACE CHECK DAMS THE DISTANCE APART WHERE POINTS "A" AND "B" ARE THE SAME ELEVATION
FLOWLINE
FLOW
EXTENDED SECTION B
6" MIN.
SACKS SHALL BE #10 BURLAP OR APPROVED ALTERNATE FILLED WITH 40 TO 55 LBS. OF GRAVEL BACKFILL FOR DRAINS.
PLACE SACKS FIRMLY AGAINST GROUND LINE AND ADJACENT SACKS.
6" MIN.
ELEVATION
SANDBAG CHECK DAM
18"
FLOWLINE
SECTION B
SPACE CHECK DAMS THE DISTANCE APART WHERE POINTS "A" AND "B" ARE THE SAME ELEVATION
WATTLE (TYP.)
FLOW
FLOWLINE
EXTENDED SECTION C
2' - 0" MAX. BETWEEN STAKES
3/4" x 3/4" WOODEN STAKE (TYP.)
6" MIN.
WATTLE
1 - 6" MIN. PENETRATION (TYP.)
6" MIN.
ELEVATION
WATTLE CHECK DAM
STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARK W. MAURER
CERTIFICATE NO. 000598
CHECK DAMS
STANDARD PLAN I-11
SHEET 1 OF 1 SHEET
APPROVED FOR PUBLICATION
Harold J. Peterfeso
07-17-03
STATE DESIGN ENGINEER
DATE
Washington State Department of Transportation


NOTES
1. MORE THAN THE MINIMUM OF ONE FASTENER PER SQUARE YARD MAY BE REQUIRED DUE TO CONDITIONS SUCH AS BLANKET COMPOSITION, SOIL TYPE, SURFACE UNIFORMITY, AND SLOPE STEEPNESS.
2. SEE STANDARD SPECIFICATION 8-01.3(3).
6" × 6" TRENCH
1' - 6" MAX. CTRS. TYP.
3' - 0" MAX. CTRS. TYP.
BLANKET EDGE
1' - 6" MAX. CTRS. TYP.
ANCHOR TRENCH (SEE SECTION)
4" MIN. EDGE OVERLAP
FASTENER TYP.
BLANKET ENDS
1' - 6" MAX. CTRS. TYP.
SHINGLE SPLICE (SEE SECTION)
3' - 0" MAX. CTRS. TYP.
6" MAX. CTRS. TYP.
PERSPECTIVE VIEW
6" MIN.
6" MIN.
EROSION CONTROL BLANKET
TAMPED NATIVE SOIL
FASTENER
FASTENER 3' - 0" MAX. CTRS.
ANCHOR TRENCH
SECTION
FLOW
6" MIN. END OVERLAP
EROSION CONTROL BLANKET
FASTENER
SHINGLE SPLICE
SECTION
STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARK W. MAURER
CERTIFICATE NO. 000598
EROSION CONTROL BLANKET PLACEMENT ON SLOPE
STANDARD PLAN I-12
SHEET 1 OF 1 SHEET
APPROVED FOR PUBLICATION
Harold J. Peterfeso 07-17-03
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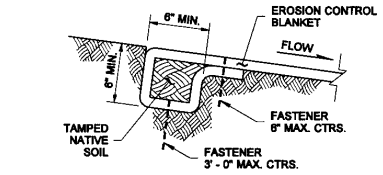
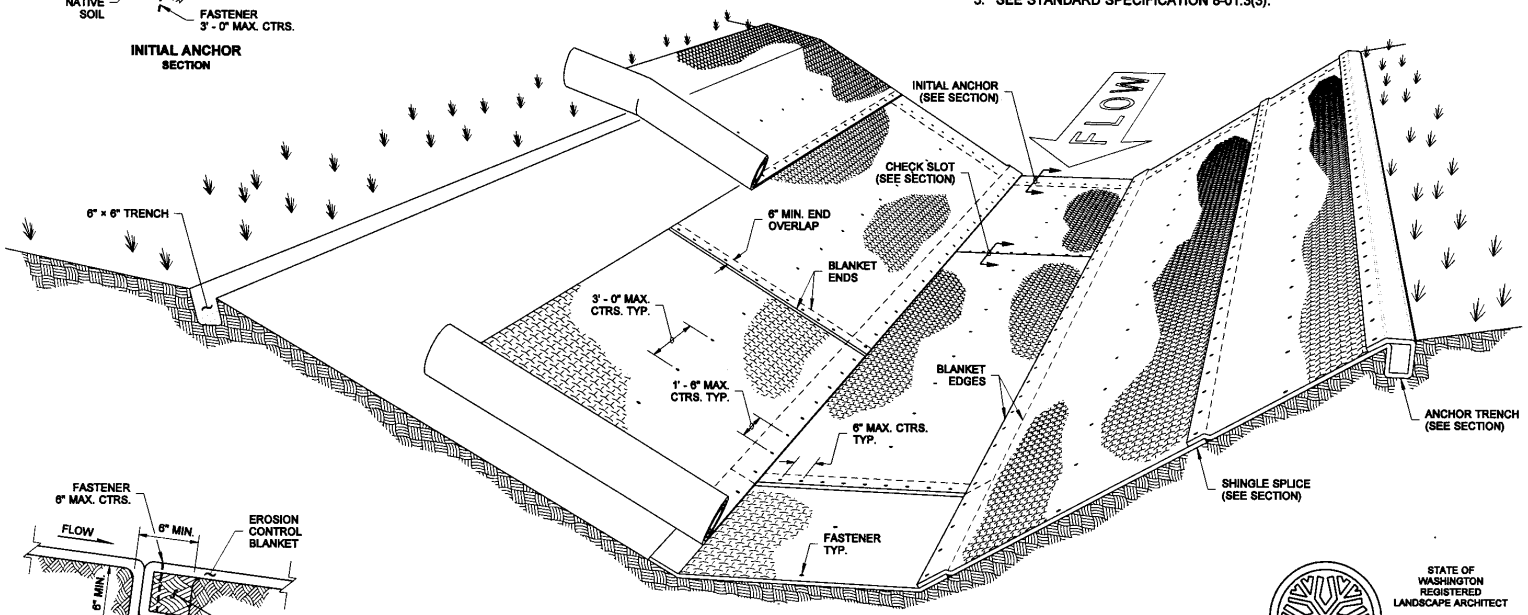
Washington State Department of Transportation



INITIAL ANCHOR
SECTION

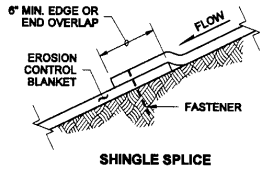
NOTES

1. MORE THAN THE MINIMUM OF ONE FASTENER PER SQUARE YARD MAY BE REQUIRED DUE TO CONDITIONS SUCH AS BLANKET COMPOSITION, SOIL TYPE, SURFACE UNIFORMITY, AND FLOW VELOCITY.
2. ROLL ENDS MAY BE SPLICED IN A CHECK SLOT.
3. SEE STANDARD SPECIFICATION 8-01.3(3).

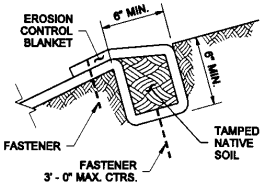


PERSPECTIVE VIEW

CHECK SLOT
SECTION



SHINGLE SPLICE
SECTION



ANCHOR TRENCH
SECTION

STATE OF WASHINGTON
REGISTERED
LANDSCAPE ARCHITECT
MARK W. MAURER
CERTIFICATE NO. 000598

EROSION CONTROL BLANKET PLACEMENT IN CHANNEL

STANDARD PLAN I-13

SHEET 1 OF 1 SHEET

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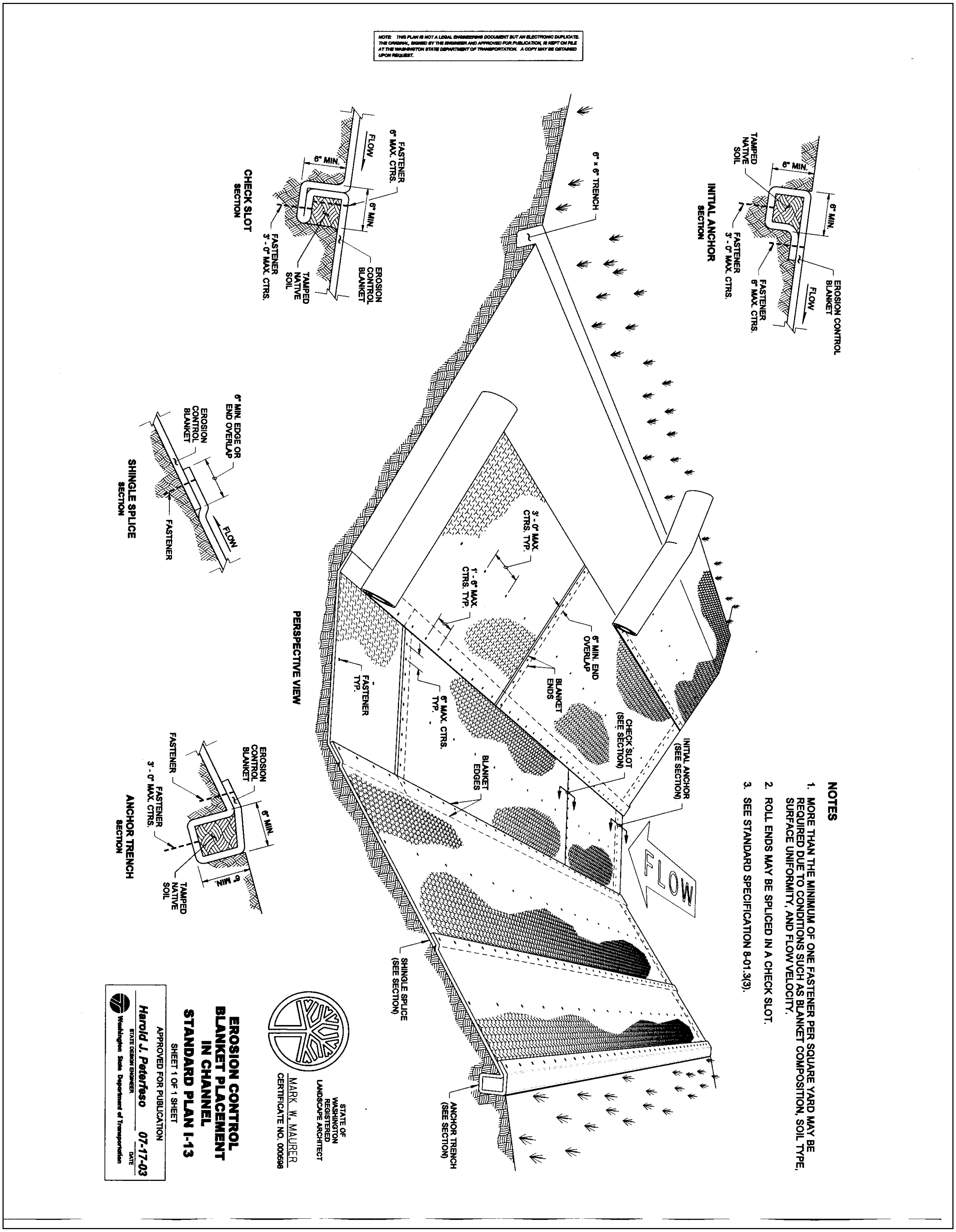
Washington State Department of Transportation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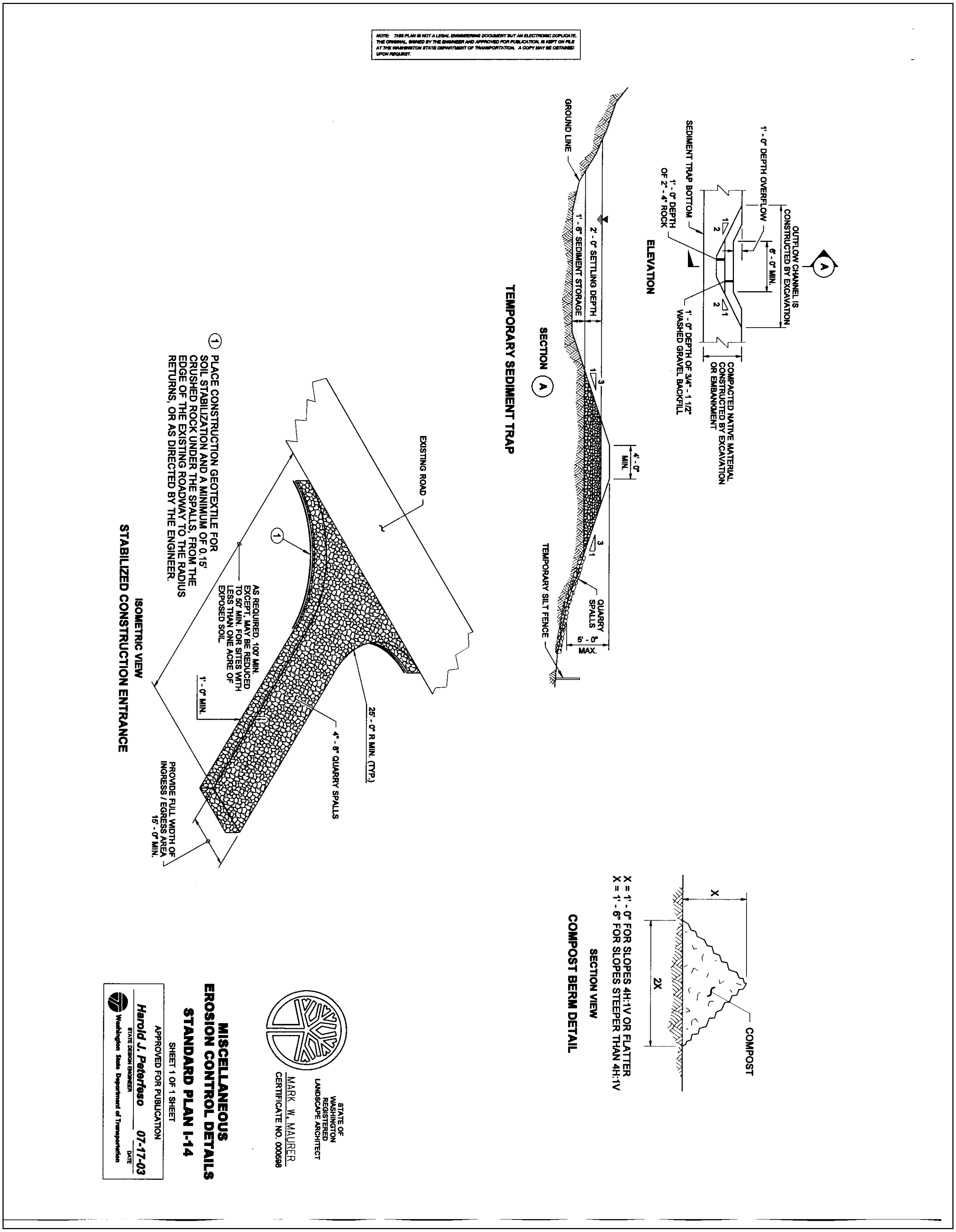
NOTES
1. MORE THAN THE MINIMUM OF ONE FASTENER PER SQUARE YARD MAY BE REQUIRED DUE TO CONDITIONS SUCH AS BLANKET COMPOSITION, SOIL TYPE, SURFACE UNIFORMITY, AND FLOW VELOCITY.
2. ROLL ENDS MAY BE SPLICED IN A CHECK SLOT.
3. SEE STANDARD SPECIFICATION 8-01.3(3).
6" MIN.
EROSION CONTROL BLANKET
FLOW
6" MIN.
TAMPED NATIVE SOIL
FASTENER 6" MAX. CTRS.
FASTENER 3' - 0" MAX. CTRS.
INITIAL ANCHOR
SECTION
INITIAL ANCHOR (SEE SECTION)
FLOW
CHECK SLOT (SEE SECTION)
6" × 6" TRENCH
6" MIN. END OVERLAP
BLANKET ENDS
3' - 0" MAX. CTRS. TYP.
1' - 6" MAX. CTRS. TYP.
BLANKET EDGES
6" MAX. CTRS. TYP.
ANCHOR TRENCH (SEE SECTION)
SHINGLE SPLICE (SEE SECTION)
FASTENER TYP.
PERSPECTIVE VIEW
FASTENER 6" MAX. CTRS.
FLOW
6" MIN.
EROSION CONTROL BLANKET
6" MIN.
TAMPED NATIVE SOIL
FASTENER 3' - 0" MAX. CTRS.
CHECK SLOT
SECTION
6" MIN. EDGE OR END OVERLAP
FLOW
EROSION CONTROL BLANKET
FASTENER
SHINGLE SPLICE
SECTION
EROSION CONTROL BLANKET
6" MIN.
6" MIN.
FASTENER
TAMPED NATIVE SOIL
FASTENER 3' - 0" MAX. CTRS.
ANCHOR TRENCH
SECTION
STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARK W. MAURER
CERTIFICATE NO. 000598
EROSION CONTROL BLANKET PLACEMENT IN CHANNEL
STANDARD PLAN I-13
SHEET 1 OF 1 SHEET
APPROVED FOR PUBLICATION
Harold J. Peterfeso 07-17-03
STATE DESIGN ENGINEER DATE
Washington State Department of Transportation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1' - 0" DEPTH OVERFLOW
OUTFLOW CHANNEL IS CONSTRUCTED BY EXCAVATION
6' - 0" MIN.
SEDIMENT TRAP BOTTOM
1' - 0" DEPTH OF 2" - 4" ROCK
1' - 0" DEPTH OF 3/4" - 1 1/2" WASHED GRAVEL BACKFILL
COMPACTED NATIVE MATERIAL CONSTRUCTED BY EXCAVATION OR EMBANKMENT
ELEVATION
GROUND LINE
2' - 0" SETTLING DEPTH
1' - 6" SEDIMENT STORAGE
4' - 0" MIN.
QUARRY SPALLS
5' - 0" MAX.
TEMPORARY SILT FENCE
SECTION A
TEMPORARY SEDIMENT TRAP
X
2X
COMPOST
X = 1' - 0" FOR SLOPES 4H:1V OR FLATTER
X = 1' - 6" FOR SLOPES STEEPER THAN 4H:1V
SECTION VIEW
COMPOST BERM DETAIL
EXISTING ROAD
25' - 0" R MIN. (TYP.)
4" - 8" QUARRY SPALLS
AS REQUIRED, 100' MIN. EXCEPT, MAY BE REDUCED TO 50' MIN. FOR SITES WITH LESS THAN ONE ACRE OF EXPOSED SOIL
1' - 0" MIN.
PROVIDE FULL WIDTH OF INGRESS / EGRESS AREA 15' - 0" MIN.
1 PLACE CONSTRUCTION GEOTEXTILE FOR SOIL STABILIZATION AND A MINIMUM OF 0.15' CRUSHED ROCK UNDER THE SPALLS, FROM THE EDGE OF THE EXISTING ROADWAY TO THE RADIUS RETURNS, OR AS DIRECTED BY THE ENGINEER.
ISOMETRIC VIEW
STABILIZED CONSTRUCTION ENTRANCE
STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT
MARK W. MAURER
CERTIFICATE NO. 000698
MISCELLANEOUS EROSION CONTROL DETAILS
STANDARD PLAN I-14
SHEET 1 OF 1 SHEET
APPROVED FOR PUBLICATION
Harold J. Peterfeso 07-17-03
STATE DESIGN ENGINEER DATE
Washington State Department of Transportation

4.7 On-Line TESC Plan Template

An example TESC plan template is available at WSDOT's Erosion Control Program Website (http://www.wsdot.wa.gov/environment/wqec/erosion.htm). This template provides the most current information and contains text box descriptions at the beginning of each section that describe what information should be included for each TESC element. Examples of descriptive text, in italics, are also provided.

Section 5

5.1 Standard Specification for SPCC Plan

2004 Standard Specifications Page 1-61
1-07.15(1) Spill Prevention, Control and Countermeasures Plan
The Contractor shall prepare a project specific spill prevention, control and countermeasures (SPCC) plan to be used for the duration of the project. The plan shall be submitted to the Engineer prior to the commencement of any on site construction activities. The Contractor shall maintain a copy of the plan at the work site, including any necessary updates as the work progresses. If hazardous materials are encountered during construction, the Contractor shall do everything possible to control and contain the material until appropriate measures can be taken. Hazardous material, as referred to within this specification, is defined in RCW 70.105.010 under "Hazardous Substances". Occupational safety and health requirements that pertain to SPCC planning are contained in WAC 296-155 and WAC 296-62.

The SPCC plan shall address the following project-specific information:

1. SPCC Plan Elements

A. Site Information
Identify general site information useful in construction planning, recognizing potential sources of spills, and identifying personnel responsible for managing and implementing the plan.

B. Project Site Description
Identify staging, storage, maintenance, and refueling areas and their relationship to drainage pathways, waterways, and other sensitive areas.
Specifically address:
- the Contractor's equipment maintenance, refueling, and cleaning activities.
- the Contractor's on site storage areas for hazardous materials.

C. Spill Prevention and Containment
Identify spill prevention and containment methods to be used at each of the locations identified in B., above.

D. Spill Response
Outline spill response procedures including assessment of the hazard, securing spill response and personal protective equipment, containing and eliminating the spill source, and mitigation, removal and disposal of the material.

E. Standby, On-Site, Material and Equipment
The plan shall identify the equipment and materials the Contractor will maintain on site to carry out the preventive and responsive measures for the items listed.

F. Reporting
The plan shall list all federal, state and local agency telephone numbers the Contractor must notify in the event of a spill.

G. Program Management
Identify site security measures, inspection procedures and personnel training procedures as they relate to spill prevention, containment, response, management and cleanup.

H. Preexisting Contamination
If preexisting contamination in the project area is described elsewhere in the plans or specifications, the SPCC plan shall indicate measures the Contractor will take to conduct work without allowing release or further spreading of the materials.

2. Attachments

A. Site plan showing the locations identified in (1. B. and 1. C.) noted previously.

B. Spill and Incident Report Forms, if any, that the Contractor will be using.

Implementation Requirements
The Contractor shall be prepared and shall carry out the SPCC plan in the event of a hazardous spill within the project limits.

Payment
The lump sum contract price for the "SPCC Plan" shall be full pay for:

1. All costs associated with creating the SPCC plan.

2. All costs associated with providing and maintaining on site standby materials and equipment described in the SPCC plan. As to other costs associated with spills the contractor may request payment as provided for in the Contract. No payment shall be made if the spill was caused by or resulted from the Contractor's operations, negligence or omissions.

Notes

Program Objectives

- Raise Your Awareness of the Value of SPCC Plan
- Increase Your Knowledge of Spill Prevention Planning Within WSDOT

Program Overview

- Introduction – Contractor's SPCC Plan
- Part I - Requirements
- Part II - Key Elements of a SPCC Plan and Program
- Part III - Summary

What is a SPCC Plan?

- Spill Prevention, Control and Counter-Measures (SPCC) Plan per Standard Specification 1-07.15(1)
- Site-Specific, Comprehensive Plan Written and Maintained By the Contractor to Prevent, Respond to, and/or Report Spills/Releases of Hazardous Materials into the Environment.

Examples of Hazardous Materials

- Petroleum Products like Gasoline, Diesel, Hydraulic Fluid and Lube Oils
- Cleaning Agents Like Bleach and TCE (Metal Cleaning)
- Lead (Bridge Paint Removal)
- Bird Guano
- Asbestos (Piping and Insulation)
- Building/Structural Demolition

Part I – SPCC Planning Requirements

Notes

Why is Spill Prevention Planning Important?

- Protects Environment and Human Health
- Personal Liability
- Best Insurance Policy to Avoid a Spill - Potential Fines

Case Study: Why Spill Planning is Important

- Bridge Replacement Contract
- Hydraulic Hose Broke Loose from Equipment
- 40- 50 Gallons of Hydraulic Oil Spilled into Major River
- Ecology Immediately On-Site.
- Spill was Covered on Nightly News in Region...WSDOT and Contractors Interviewed!
- $1000 Fine to Contractor for Spill. Not all Fines have been Assessed.
- Appropriate Spill Equipment not On-Site.
- Second Spill Resulted in Project Shut-Down.

Regulatory Drivers

- **Federal and State Requirements**
  - Water Quality Regulations
  - Endangered Species Act (ESA)
  - CERCLA/Superfund & MTCA
  - RCRA/Dangerous Waste
  - UST Regulations
  - Labor & Industries (L&I)

Notes

Part II - Key Elements of a Spill Program

1. Site Information and Project Site Description
2. Spill Prevention and Containment
3. Spill Response
4. Standby, On-Site Material and Equipment
5. Reporting
6. Program Management
7. Pre-Existing Contamination
8. Site Plan and Reporting Forms

Notes

1. Site Information Project Site Description

- Overview of the Project and Its Location
- Identification of Hazardous Materials Associated with the Project
- Identification of Staging, Storage, Maintenance, and Refueling Areas
- Identification and Proximity to Sensitive Areas (e.g., People, Streams, Rivers, Wetlands)
- Management of the SPCC Plan

Site Conditions for Consideration

- Items Brought On-Site
- Pre-Existing Site Conditions
- Unknown Conditions

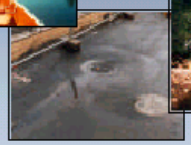
Potential Sources of Spills and Releases - All Environmental Media

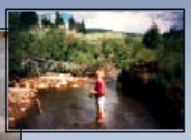
- Fuel and Hazardous Material Storage Containers
- Equipment - Hydraulic and Fuel Lines
- Buried Tanks and Piping
- Stockpile of Contaminated Soil
- Sandblasting Bridge Structures
- Concrete Pouring Activities

Notes

Recognition/Awareness of Sensitive Areas/Receptors

- People (Both On / Off Site)
- Natural Resources (e.g., Drinking Water Aquifer, Creeks / Streams)
- Wildlife (e.g., Plants, Animals, Habitat)





Notes

2. Spill Prevention and Containment

- Identification and Implementation of Prevention and Containment Methods for Hazardous Materials Associated with the Project
- Focus on Implementing Spill Prevention Strategies

Spill Prevention Strategies

- Use Non-hazardous Materials (if possible)
- Decrease Quantity of Hazardous Materials brought on Site
- Minimize Quantity of Hazardous Wastes Generated and Stored on Site
- Use Proper Equipment to Transfer Materials (e.g. Funnels, Pumps, etc.)
- Implement a Preventative Maintenance Program for Equipment

Spill Containment Strategies

- Provide Secondary Containment for Hazardous Materials & Wastes
- Utilize Berms and Storm Drain Covers
- Isolate and Cover Areas of Contaminated Soil Storage Piles

3. Spill Response

- Ability to Make Quick and Appropriate Decisions
- Hazard Assessment
- Determine Whether Resources (e.g., Trained People, Equipment, Supplies) Exist on Site
- Contract with an Emergency Responder (If Needed)
- Appropriate Response Equipment and PPE for the Potential Spill Sources
- Spill Containment and Source Elimination
- Spill Clean-Up, Habitat Restoration, Removal and Waste Disposal

Sample BMP

- BMP – If Soil Contamination is Discovered:
  1. Stop Work – Secure Area to Prevent People from Entering Area.
  2. Notify Project Supervisor and WSDOT Project Inspector.
  3. Project Supervisor and WSDOT Project Inspector Evaluate Situation.
  4. Sample and Analyze the Contaminated Soil.
  5. Suspected Contaminated Soil Should be Lined and Covered with Visqueen.
  6. Manage, Store, Ship and Dispose of the Soil Consistent with Regulatory Requirements.

Notes

Waste Management

- Segregate
- Manage
- Ship
- Proper Disposal

Notes

4. Standby, On-Site Material and Equipment

- Identify Equipment and Materials that will be Maintained on Site to Implement the Preventive and Responsive Measures of the SPCC Plan

5. Spill Reporting

- List all Agency Phone Numbers in Case of a Release or Spill
  - Local (e.g., Police, Fire Department)
  - State
  - Federal

Reporting Spills - Media Specific

- **Spill to Water (e.g., Stream, River, Puget Sound):**
  - National Response Center (1-800-424-8802)
  - Washington State Emergency Management Division (1-800-258-5990)
- **Immediate Notification if:**
  - Water Quality Standards are Violated
  - A Persistent Sheen Occurs
  - A Sludge or Emulsion is Produced
  - A Hazardous Material or Oil is Released

Reporting Spills - Media Specific (cont.)

- **Spill to Soil/Land:**
  - Department of Ecology, Toxics Clean-up Program (1-800-407-7170)
- **Notification Timeline:**
  - Immediately, if a Release of Hazardous Material Threatens Human Health or the Environment
  - Within 24 hours, if a Release Occurs from an Underground Storage Tank (UST) that Threatens Human Health or the Environment

How Should Spills Be Reported?

- **The Contractor Reports Spills to the Appropriate Agencies and WSDOT Project Representatives**
- **Verbal *and* Written Notification may be Required by the Contractor or WSDOT**

Notes

6. Program Management

- Site Security Measures (Fences, Locks, Lighting, Signs, Barricades)
- Daily and Weekly Inspections
- Proper Training for Employees

7. Pre-Existing Contamination

- IF Pre-Existing Contamination is Known at the Project Site:
  - The SPCC Plan Must Indicate the Measures that Will be Implemented to Conduct Work Without Allowing Release or Further Spreading of the Material.

8. Site Plan

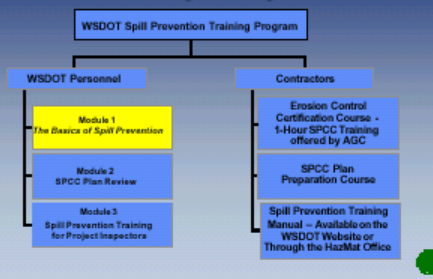
- Valuable Tool for Summarizing Information
- Recommended Contents
  - Outline of Project Work Area
  - Location of Potential Spill or Release Sources
  - Gradient Direction/Slope of Site
  - Location of Sensitive Areas/Receptor
  - Location of Spill Response Kits/Equipment

Notes

8. (cont.) Spill and Incident Report Form(s)

- Establishes a Standardized Reporting Process
- Example is Available in the Contractor's SPCC Plan Templates and Tools

WSDOT's Spill Prevention Training Program



Resources

Hazardous Materials Staff

- **Melany Vorass,** Hazardous Materials Lead; (360) 570- 6658
- **Allison Ray,** Hazardous Materials Specialist; (360) 570- 6649
- **Tanya Peterson,** Environmental Intern; (360) 570- 6653

Hazardous Materials Program Web Page

- http://www.wsdot.wa.gov/eesc/environmental/programs/hazwqec/hazwqec.htm
- SPCC Plan Guidance
- Internet & Publications Resource List

Notes